BBC MICRO USER

Volume 1 No. 2
April 1983 £1

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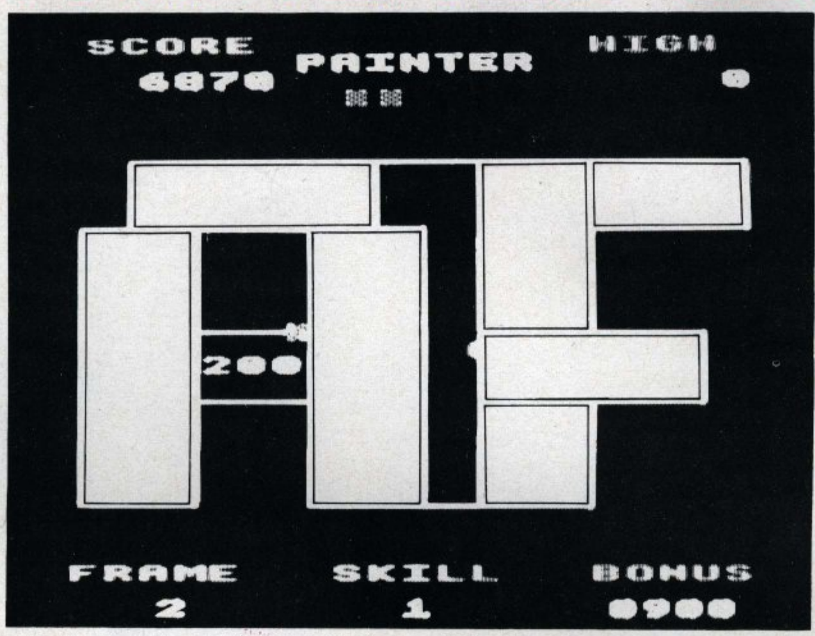

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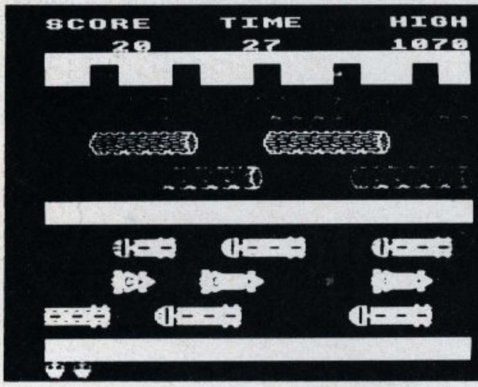

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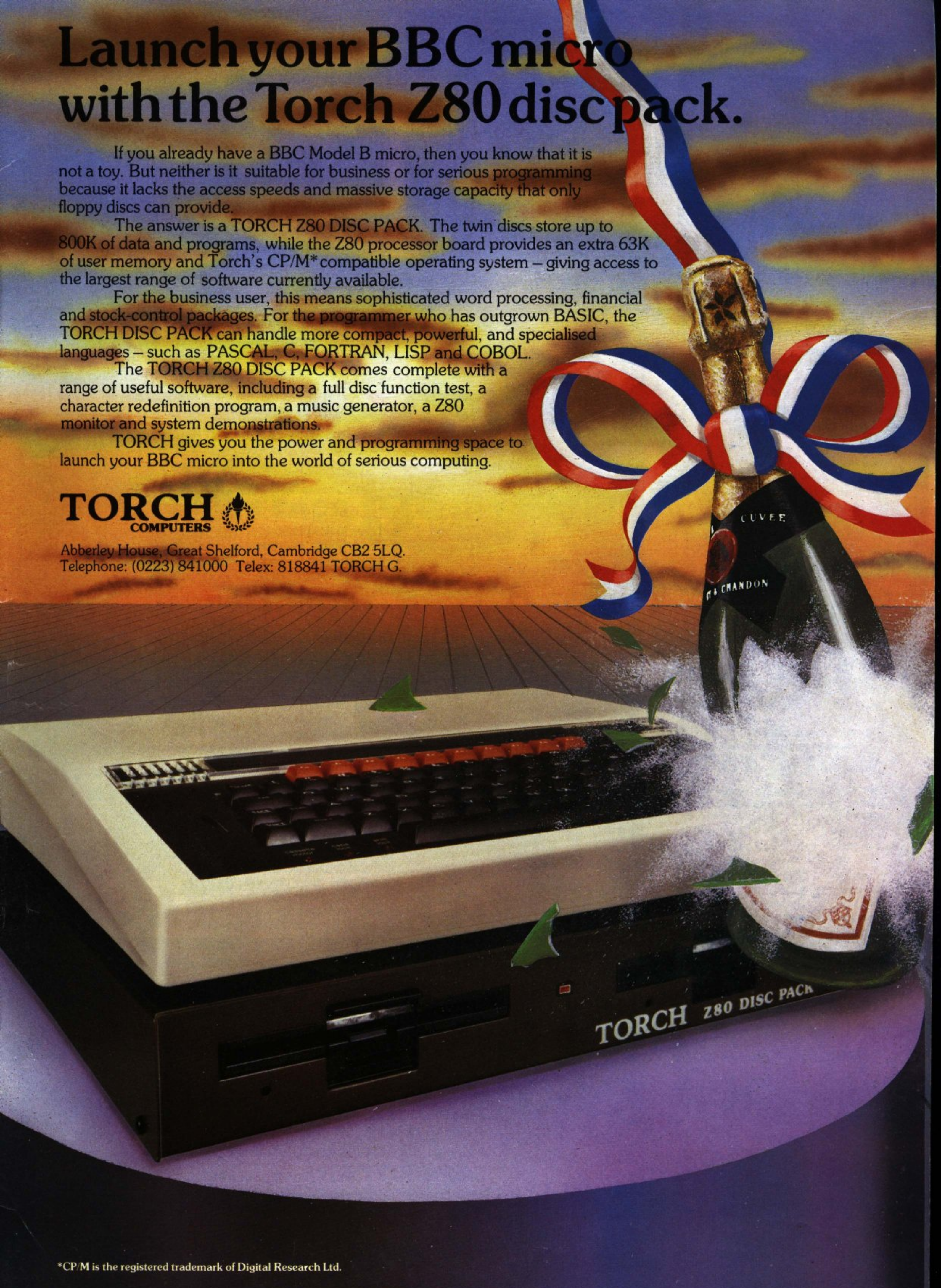

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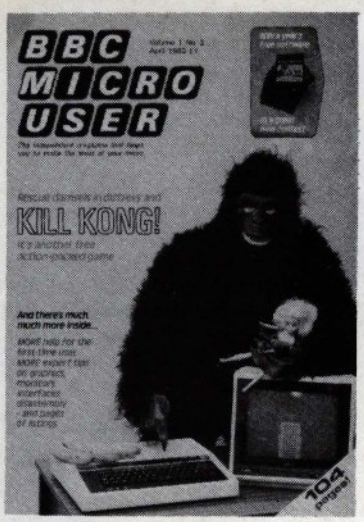

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BBC Micro User welcomes program listings and articles for publication. Material should be typed or computer-printed, and preferably double-spaced. Program listings should be accompanied by cassette tape or disc. Please enclose a stamped, self-addressed envelope, otherwise the return of material cannot be guaranteed. Contributions accepted for publication will be on an all-rights basis.

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Editorial

A SUPERB RESPONSE

WELCOME to the second edition of BBC Micro User – larger and more colourful than the last!

I was overwhelmed by the response to the first edition. Thanks for all the letters, and please keep them coming in. Every one is read and the points they raise seriously considered.

I'd be grateful if you would give your telephone number as well as your full address – it would be impossible for me to reply to all of your letters, but it's nice to have the option.

This month sees the start of Bits and Bytes, a series for non-experts that will eventually lead up to assembly language programming.

There were also requests for more of the "hard stuff". Well this month, as well as discussing the Basic keywords' action addresses in Programmers' Workshop, we give a full listing for a hex dump/disassembler. In future issues we shall be using this to probe the working of the BBC Micro's ROM.

Deathwatch produced a large crop of letters, almost all praising the game highly. One or two people had difficulty typing it in. The BBC Micro seems to be particularly prone to "invisible" typing errors, so we've devoted a whole article to typing in listings. Let's hope that solves some problems.

Mind you, we didn't make the task of typing the programs in any easier by providing you with listings that were faint in places. Sincere apologies – it won't happen again. Oddly, only a couple of letters mentioned that problem – you're a very charitable lot!

The response to the review of monitors was gratifying. It seems there is a huge demand for objective tests of hardware, so we've provided some test card programs for monitors. We shall be doing reviews of discs and printers soon.

Is there anyone out there who can give us an objective set of benchmark programs that we can use as criteria for evaluating these? If so, we would be glad to hear from you.

The same goes for would-be contributors. We have already received some excellent articles and programs, but are always on the lookout for more.

Mike Bibby

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> (Which Micro & Software Review Feb 83)

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* Print the tabulated results in an elegant report format.
* Experienced users may access saved files and write their own reporting or graphics presentation programs for the results.

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* Small business accounting applications, e.g. profit and loss statements and cashflow projections, break-even analyses etc.
* Investment project appraisal – anything from double glazing to oil rigs!
* Comparing rent/lease/buy options
* Processing the results of scientific experiments or field studies
* Engineering calculation models
* In fact, anything that involves repeated re-calculation of results presented in tabular or spreadsheet format.

Program Availability Chart:–

	Database	Stock Control	Mailist	Invoices & Statements	Spread sheet Analysis	Cashbook Accounting	Word processor	Home Accounts	Commercial Accounts
Sinclair Spectrum 16k or 48k	●	●	●					●	●
Dragon 32k or 64k	●				●			●	
VIC20 (16k+)	●	●	●	●				●	●
Sinclair ZX81 (16k+)	●								
Grundy Newbrain	●								
Texas TI99 4A	●								
Atari 400/800 or Osborne 1	●								
Sharp MZ80A	●	●	●	●				●	●
Sharp MZ80K	●	●	●	●				●	●
Sharp MZ80B	●	●	●	●				●	●
BBC micro model A or B 32K	●	●	●	●	●	●	●	●	●

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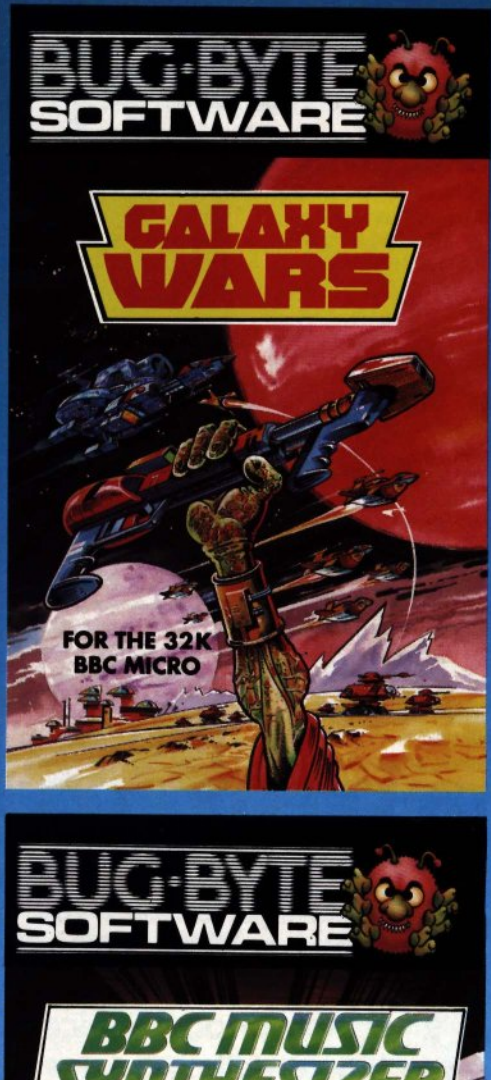
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BBC MICRO USER

April 1983

NEWS

Econet given the ITC seal of approval

● *An Econet system links these BBC Micros with other classrooms at Felsted School, Essex.*

ECONET – the low-cost networking system that can allow up to 254 BBC Micros to communicate with each other – gets a massive boost with news that it has been given an official seal of approval by Britain's 200 Information Technology Centres.

At the same time Acorn has revealed that sales of Econet systems have now reached 250 a month.

More than 500 BBC Micros have been installed in ITECs, which were set up by the Department of Industry and the Manpower Services Commission to train school leavers in computing skills.

Econet chief Peter O'Keeffe, who is Acorn's networks manager, said its big attraction was its cheapness. Setting up an Econet network cost £50 for each micro on the system – just a quarter the cost of the nearest comparable system.

"It makes networking a reality for so many different kinds of organisations", he said.

Inexpensive

"In business it is used for internal communications and electronic mail. In industry it becomes an inexpensive data collection and manipulation system, eliminating the need for a central computer to poll the data collection points.

"And in education it means disc storage, printers and other expensive peripherals can be shared – with teachers viewing one or more pupils' screens from a remote terminal."

Acorn have announced there are to be two versions of Econet. The first, due out at the end of this month, requires the use of one of their earlier systems to act as the network's "administrator". The second, to be released at the end of July, uses a BBC Micro with second processor in this role.

The second processors themselves, planned to go on sale this month, have been delayed. They will not be officially launched until the end of June.

SALES SOAR

SALES of the BBC Micro have broken new records, and the production target has been increased to 12,000 a month in order to meet the ever-increasing demand.

Latest figures released by Acorn show that in February nearly one out of every five customers paid extra to have the Econet interface fitted.

Most were for the educational market. But a substantial number went to multiple users such as British Telecom, the DHSS and the National Physical Laboratory.

Getting down to Basics

WHEN is a new Basic not a new Basic? Apparently when it's Acorn who've issued it.

Despite earlier assurances to the contrary, there is a different version of Basic going out with present machines.

This has been confirmed by an Acorn spokesman. He told *BBC Micro User* that the Basic "wasn't different, but it was transparent". Some minor bugs had been removed but programs that worked with the old Basic would definitely run with the new.

The latest Basic is said to be much more accurate. However, according to some dealers, it's still far from perfect. One snag is that it cannot even divide by ten properly.

For example, something like 576 divided by ten gives 575.9999 etc. And that can cause problems if you're using the result of such a calculation in a TAB statement.

At least one software house is also said to be having difficulties with the new basic.

CASSETTE BREAKTHROUGH

AT last there is a source of cassette recorders guaranteed to work on the BBC Micro – Leasalink Viewdata Limited (LVL).

They have been adapting cassette recorders so that they are fully compatible with the BBC machine. Each modified cassette comes with an LVL certification label.

LVL are best known as the distributors of the BBC Micro to the trade.

Less well known is that they are one of the country's foremost exponents of viewdata technology, currently working on several new projects.

They are also implementing Hero, a networking facility designed specifically for computer assisted learning.

Revision

Their latest venture has been prompted by the revision of the golf handicapping rules – a task which is causing golf clubs all over the country to cry out for assistance.

LVL have brought out a program which not only solves this problem but aids the clubs with other housekeeping duties.

The whole package, which includes a BBC Micro with dual disc drives, costs well under £2,000.

A quarter million dollar USA launch for BBC Micro

BBC personality David Jacobs has been chosen to star in a promotional videotape which will be used to spearhead Acorn's drive into overseas markets.

Copies will be sent to every country on Acorn's export list and will be shown to firms interested in taking on dealerships for the BBC Micro.

Apart from describing the many advantages of the BBC Micro, golden-tongued David also introduces many of the peripherals now available for the machine.

ACORN joint managing director Chris Curry is back from a flying visit to Boston, where he has been putting finishing touches to the launching of the BBC Micro on the American market.

Meeting in the spanking new headquarters of the recently formed Acorn Computer Corporation, he has been holding a series of high powered meetings with his advertising and PR executives approving plans for D-Day – April 16.

That is when the prestigeous Public Broadcasting System starts screening the BBC's "The Computer Programme", which we saw here a year ago. And it coincides with the start of a coast-to-coast publicity campaign to boost the BBC Micro.

For Acorn, persuading the American TV chiefs to take the series was an expensive undertaking. It cost them a cool quarter of a million dollars – well over £160,000.

But Acorn are convinced it will be money well spent. Despite the tremendous competition they are up against, they are predicting they will be able to sell between 60,000 and 80,000 BBC Micros in the United States in the next 12 months.

American magazines are forecasting that the BBC Micro will take the US market by storm.

One reviewer calls it "the most verstile small general purpose computer I've ever seen."

The Americans rave over the BBC Micro's exceptional graphics and its potential for expansion: "The graphics and colour quality are better than anything we have seen in a personal computer."

The lack of a disc system as standard gives rise to one of the few criticisms. In the States cassette storage is considered archaic.

One writer explains its use by stating that "In the UK disposable income is not as available as in the United States." He probably means we're poorer over here.

The DFS used by Acorn is also generally considered to be "primitive and slow."

Despite this, general agreement is that with the development of the BBC Micro the British have stolen the lead from the Americans in the field of personal computers.

WORDWISE ROM IS WAITING FOR THAT 1.2 MOS

SALES of Computer Concepts "Wordwise" word processor ROM are soaring. Well over 1,000 are now in use and orders are still pouring in.

Charles Moir, managing director, said: "We're not surprised. It's an excellent piece of software and is rapidly becoming a standard in the field.

"The only thing that's holding us back is the wait for the new 1.2 MOS from Acorn. Our system needs 1.0 or over.

"Once 1.2 is readily available we expect to exceed even our present sales."

Following on this success Computer Concepts are planning to produce a whole series of ROMs covering machine code and disc utilities, as well as business applications.

Spreadsheet?

Ready for release as soon as the documentation is finished is a machine code debugging ROM, which will be followed shortly by a ROM-based spreadsheet program promised to be "very powerful".

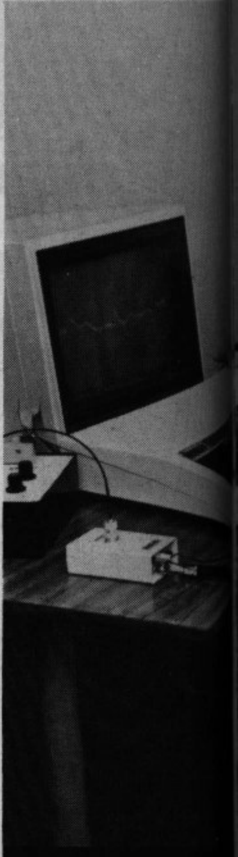
Sideline takes over..

FOUR BBC Micros, linked in a working Econet system, were the stars at the opening of a new showroom for BBC Micros in Bradford.

A local firm, Eltech, took up an Acorn dealership in 1981.

The reason, according to Catherine Tweddle, one of the directors of the company, was: "It seemed at the time like a good idea for a sideline."

It was the phenomenal growth of that sideline that necessitated the new showroom, with its ranks of BBC Micros, software and books.



BBC Micro gets into brain waves

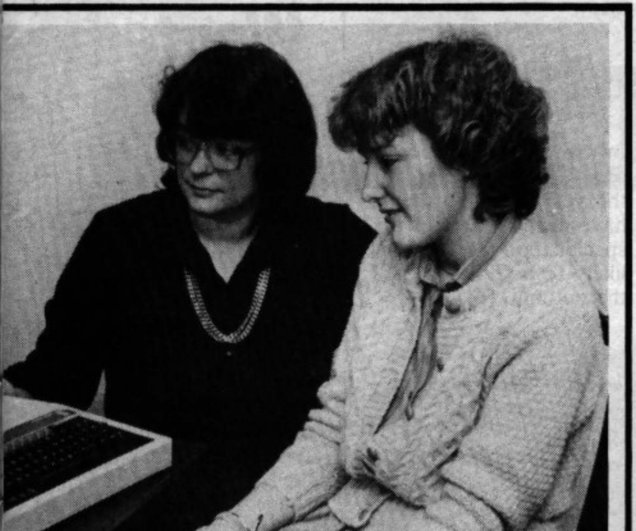
USING the latest technology, Blackboard Electronics have linked an electronic ECG to the BBC Micro.

It uses a length of optical fibre coupled to an opto-isolator to ensure that the patient is isolated from the mains power source.

Retailing at £46, the unit has the advantage that its electrodes do not require the use of saline gel, as they are mounted on velcro straps.

The firm has been inundated with requests for its range of BBC interface products, particularly from educational establishments.

Coming soon is an electronic stopwatch which measures to an accuracy of one microsecond.



ACORN JOIN IN WITH PROJECT UNIVERSE

THE BBC Micro has been called in to play a leading role in a massive £3 million project designed to considerably expand the use of micros in high speed, long distance communications via satellite.

Acorn's top engineers are the latest recruits to the three-year Project Universe, a unique collaboration between the government, universities and private industry.

The aim of this world-beating programme is to develop economic ways of enabling simple network terminals, such as the BBC Micro under Econet, to talk to mainframe computers in any country.

This will give them access to vast stores of information held on the world's largest computers.

The first public demonstration of the BBC Micro's role in this ambitious enterprise came last month when BBC machines in London and Cambridge talked to each other via satellite.

This was made possible by a special interface developed by Acorn subsidiary Orbis Computers. They are now working on several unique devices for high speed communication between computers that will be used as part of Project Universe.

Demonstrated

Orbis general manager Peter O'Keeffe said: "We have now demonstrated that the BBC Micro is capable of being used in three different levels of networking – Acorn's own Econet system, which is used principally in educational computing, over the public telephone line via an RS423 link, and connected to the high speed Cambridge Ring."

The Ring is a pioneering system in which packets of digitised information circulate at a data transmission rate of one megabit a second.

At the heart of the project is the Orbis-designed interface based on the Motorola 68000 microprocessor. This latest state of the art chip is capable of handling up to one million instructions a second.

Graphics

As many as 12 more of these satellite links are now being made for the next stage in the development of Project Universe.

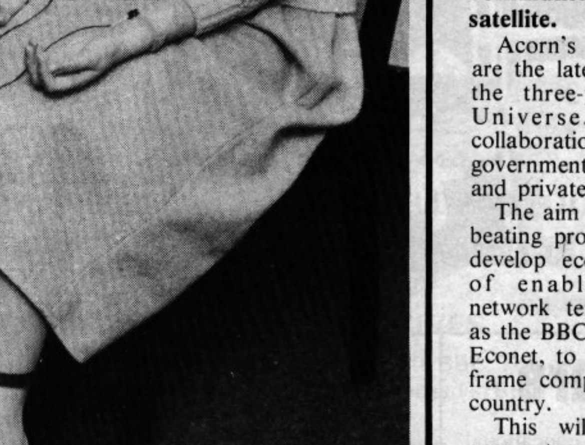
Other teams actively involved in Project Universe are from University College London and Loughborough University who are operating the BBC Micro as an interactive graphics terminal, using a low-cost system also developed by Orbis.

They have already carried out successful experiments with high speed transfer and retrieval of text and pictures to and from remote databases.

Using this method they can store individual screen frames for image analysis.

Acorn engineers are also working in close collaboration with specialists at Cambridge University and the Science and Engineering Council's Rutherford Laboratory.

Although much of Project Universe's activities is still in the development stage, a pilot scheme is expected to get under way next year in which banks and insurance companies will be invited to use the satellite links for international data transmission experiments.



```
MICRONET 800 <C>            60060a        0p
         talking              Your
         back to              Exciting
         micronet             Micronet
                              GATEWAY

                              GOTO 3
GOTO
15 MAILBOX
11 Telesoftware - your Feedback To Us
12 Send us a Story - we may print it!
13 Letters,views,info to the Editor
14 Advertise with MICRONET
10 Armchair Shopping
16 Telex Trial      21 Agony Aunt!
17 Wrong Routes     22 Jargon definitions
18 Compliments      23 Education feedback
19 Complaints

  To Computermart      - GOTO 8
  To News/Information  - GOTO 9
```

LAST month's launch of BBC Micro User coincided with the start of Micronet, the new over-the-telephone electronic magazine. And our arrival was duly recorded in Micronet's news section, with a two-page story about our plans.

However, the attraction of the new service is not so much its ability to provide micro enthusiasts with up to the minute news about their favourite machine as its provision of downloadable software.

Free

When the service opened there were 100 free programs ready for BBC users, as well as 50 programs with a price tag, ranging from 50p to £8. One of the first programs to go on line via Micronet was the arcade game Deathwatch, which we featured in last month's BBC Micro User.

Already more than 10,000 people have applied to join Micronet. One in four of them are users of the BBC Micro.

Norweb loan for a micro!

FIFTY pounds towards your BBC Micro and an interest-free loan for the rest! That's the offer the North West Electricity Board have made to their staff.

On top of this generous offer, they are prepared to pay the fees of any of their staff who undertake an approved National Extension College Basic course.

Not surprisingly, there has been a great response. Norweb have even organised a competition to find the best piece of job-related software written by their staff.

Are there similar schemes under way in other firms? If readers know of any, please write and tell us.

Mars business system for Z80

PROSPECTS for the BBC Micro to be considered as a serious business machine have been greatly enhanced by Torch Computer's release of a version of Mars on their BBC Micro Z80 disc system.

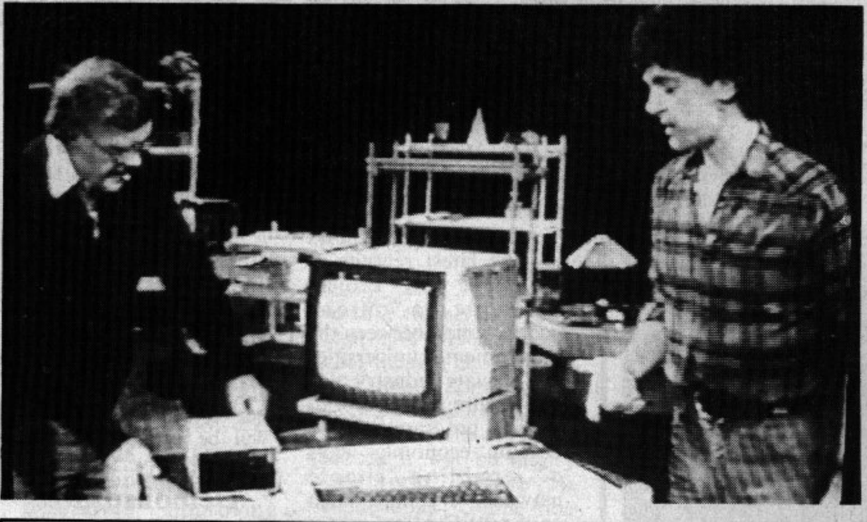
Mars – which stands for Management Accounts and Reports System – now available on a wide range of micros, is regarded as one of the best in its field. It is, in fact, only the first of a whole new range of software products now planned by Torch.

Meanwhile Acorn's own business machine is promised for the end of the year. Even so they'll have to move fast as the specification itself is unlikely to be finished until the autumn.

Dr Music likes Micro

STAR of the BBC-TV series, "Make the Most of Your Micro", has undoubtedly been fuzzy-haired Dr David Ellis, one of Britain's foremost exponents of computer music. Last month he was seen giving a virtuoso performance as he demonstrated some of the musical capabilities of the BBC Micro to presenter Ian McNaught-Davis (seen with him in our picture).

Said David: "I think the BBC Micro has great potential for making music. It could become one of the most cost-effective sound systems available."



Primary software

THE loan of one of the first BBC Micros to a Hampshire primary school has led directly to the formation of Bourne Educational Software, a company devoted solely to providing educational software for the primary age group.

"Unlike so many others in this field we design our programs with teachers fully involved right from the start," said one of the founders, David Spurling.

One unusual feature of the programs' structure is that they incorporate a monitor which allows adults easy access to details of the child's performance.

COLOUR GALORE

MORE than four billion different shades of colour can be produced on the BBC Micro, according to software house Gaelsett.

By adding two easy-to-use commands to the BBC's Basic their Extended Colourfill Graphics package gives the micro capabilities only to be found on machines costing many times the price.

Cost of the package is £10.

COMPUTERSPEAK

TO Jane Jackson, one of our reviewers, congratulations on her impending motherhood. Congratulations, too, on her managing to convey the information in terms that even our computer-fixated editor could understand: "Did you know I'm going to have a micro-programmer?"

Wanted – a girl micro mech

WANTED – a female computer engineer to work on BBC Micros! No, it's not sex discrimination, it's just that Lyn Farmer, managing director of Microstyle, wonders if they exist.

Says Lyn: "We employ mostly women here, not because it's a matter of policy, but because we find that females do the work better than men.

"They're better at selling, and they are more administratively oriented."

The formula must work. With outlets at both Newbury and Bath, Microstyle has gone from strength to strength since it was founded three years ago.

Lyn, who originally worked as a secretary until she decided to go solo, said: "If you can manage a boss, you can manage anything."

So if you're an ex-secretary who's into fixing BBC Micros, why not give Lyn a ring?

***GOOD NEWS:** The speech synthesis ROM will be out at the end of May, costing £60.*

***BAD NEWS:** It takes up 6k of memory in use.*

BARRY WOOD'S TAILPIECE

IT'S not different – it's transparent." That's the latest comment from Acorn about the new Basic ROM.

Well, perhaps our editor swallowed that, but I'm sure those of us who've suffered from Acorn's ROM saga in the past will be more sceptical.

We're too used to Acorn's announcements. And as for this one, well, "it's not different – it's transparent."

* * *

I'M sure we're all excited to know that Acorn have taken a giant step for mankind and brought the BBC Micro into the world of satellite communications.

Might I suggest that someone at Acorn try ringing the phone number they give on their literature? The lack of response they get might prompt them to take a giant step into the world of the telephone.

* * *

SOMEWHERE at Acorn there is a genius. I can picture him now, all acne and enthusiasm, beavering away in a basement. It's he who is responsible for the steady flow of operating systems, basics and disc filing systems, each better than the previous version – or at least with a few of the mistakes corrected.

In the interests of us all, why don't Acorn rescue this genius from the depths, take him outside and shoot him?

* * *

LATEST academic pronouncement that affects we "toy" programmers – or micro enthusiasts, as we like to be known – is to the effect that the proliferation of these monstrous machines is causing our children to become "intuitive" programmers.

This is supposed to be a bad thing.

The academic mafia, it would seem, would rather that we protect our children from undisciplined doodling with the malignant micro until they reach the rarified atmosphere of the universities.

There they shall be taught at the altar of mainframes, learn well the rituals of structure, and speak in tongues of Pascal.

I'm all in favour of intuitive programming. I don't think that messing about with Basic will spoil them for higher things.

As our beloved editor quotes in his forthcoming book, Zen in the Art of Computer Programming: "When the programmer is ready, the language will come."

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TELETEXT MODE 7

By PAUL LEMAN and STEVE SWALLOW

AT first sight MODE 7 looks as though it will produce easily readable characters but not much else. With a little effort, however, it can be made to produce most of the effects available in text in other modes as well as giving a low resolution (80x75) graphics capability.

MODE 7's effects are achieved by using special non-printing characters as used in Teletext. Pages 486 to 489 of the User Guide give tables of these. They are the characters with Ascii codes 129 to 159.

The major advantage of using this mode is that the entire display occupies less than 1k (1024) bytes of memory, leaving quite a lot left for programs. An example is the program "Kingdom" on the Welcome tape. It is nearly 9k and still has impressive graphics.

The effects available include:-

- Seven colours and flashing characters.
- Low resolution graphics (80x75).
- Seven background colours.
- Mixing of any display and background colour.
- Hiding and revealing text portions on the screen.
- Enlarged (double height) characters.

MODE 7 however does not allow redefinition of characters as in other modes.

The format and colour of the display is controlled by special "hidden" characters. These act as "switches" and take up character positions on the screen appearing as "blanks".

In all the other modes the format of the text is changed by altering parameters in the machine operating system.

The characters can be sent to the screen via PRINT or VDU statements.

All of the effects apply only to the line on which the special character is printed, unlike other modes where changes of colour etc, apply "until further notice".

When programming MODE 7 care must be taken in planning the display because the presence of hidden characters in the text may cause unexpected indentation or long gaps between characters. Most functions are set with a single special character, some effects however need two or more of these characters.

Coloured text in MODE 7

We will call the special character that changes the foreground colour the colour character. By placing a colour character in the output, characters following it will be displayed in the new colour until either:

a. The end of a physical line (column 39) is reached, or

b. Another colour character changes the colour again.

The colour character itself is printed as a space. For example, the alphanumeric colour character for red is CHR$129. Thus to print a line of text in red either of the following would do:

```
100 PRINT CHR$129"RED letter day."
```

or:

```
100 VDU 129
105 PRINT"RED letter day."
```

Note that the text starts in column 1 (second character in) because the colour character appears as a space. This is unavoidable.

The colour of a word can be changed by changing the colour character. The whole word does not have to be reprinted.

If the colour character preceding a word or phrase or line is at position

X,Y on the display then the following procedure will change its colour to New. For alphanumerics New must be in the range 129 to 135.

```
100 DEFPROCnewcol(X,Y,New)
110 LOCAL X1,Y1
120 X1=POS:Y1=VPOS
130 VDU 31,X,Y,New,X1,Y1
140 ENDPROC
```

A phrase or word in the middle of a sentence is always preceded and followed by a space (well almost always). If colour characters are used instead of spaces the word will be coloured. The second colour character at the end of the phrase returns the printing to the original colour.

Example 1: The word MISTAKE must always be printed in red wherever it occurs:

```
  10 MODE 7
  20 M$=CHR$129 +"MISTAKE"+CHR$135
  30 REM CHR$129=RED,135=WHITE
  40
  50
 100 PRINT"YOU HAVE MADE A";M$;"IN ANSW
ERING"
```

Example 2: A general function that prints a word in a given colour:

```
  10 MODE 7
  20 DEF FNdisplay(word$,colour)=CHR$(c
olour)+word$+CHR$135
  30 red=129:green=130:yellow=131:blue=
132
 100 PRINT"THE NEXT WORD IS";FNdisplay(
"RED",red)
 110 PRINT"BUT THIS WORD IS";FNdisplay(
"GREEN",green)
 120 PRINT"HOWEVER THE  WORD";FNdisplay
("BLUE",yellow);"MAY CONFUSE SOME PEOPLE
"
```

Altering the background colour

The background colour can be altered in a similar way to the foreground colour although one extra control character is required.

The character CHR$157 sets the background colour to the current foreground colour for that character (which appears as a space in the new colour) and all subsequent characters until the end of the line or a second occurrence of CHR$157 or of CHR$156. This last character CHR$156 switches back to a black background.

Since the background colour set by CHR$157 is the current foreground colour (usually white) the text on the screen merges with the background and cannot be seen. To reveal the text the foreground colour must be changed again after the occurrence of CHR$157.

Users will find the VDU command helpful in setting up the foreground/background colours since several colour characters are needed.

```
100 VDU 157
Line goes white
100 VDU 157,129
Line goes white, text red
100 VDU 129,157,130
Line goes red, text green
(three characters indentation)
```

Flashing characters

Text or graphics can be made to flash from the foreground to background colour by the use of CHR$136, and can be returned to normal with CHR$137.

```
100VDU 129,157,136,130
105 PRINT"Flash green on red."
```

Double height characters

Many of the Welcome programs use large characters for their titles, and these are obtained using CHR$141. This control code will cause all the remaining characters on a line to be printed in large mode. This effect can be turned off with CHR$140.

You will notice that if you type VDU 141 as a direct command then the following line you type in displays the UPPER HALF of the large letters. The line below that displays nothing.

To obtain full large letters the text and CHR$141 must occur on consecutive lines.

The following example uses a procedure that will print a string of double height characters at position X,Y on the screen. There are limits on X,Y (not checked by the program). X must be greater than 1 and Y must be less than 23, because two rows are needed.

```
 10 MODE 7
 20 PROCbig("hello",10,10)
 30 END
100 DEFPROCbig(text$,X,Y)
110 LOCAL oldX,oldY
120 oldX=POS:oldY=VPOS
130 VDU 31,X-1,Y,141 :
    Big letters from column X
140 PRINT text$;CHR$140:
    Print text and turn big letters off
150 VDU 31,X-1,Y+1,141:
    Second row
160 PRINT text$;CHR$140
170 VDU 31,oldX,oldY  :
    Restore cursor
180 ENDPROC
```

Colour control codes apply to big letters, but only to the line on which they occur. Thus it is possible to have big letters whose upper and lower halves are in differing colours with differing backgrounds.

Graphics characters

As mentioned earlier, MODE 7 also has a low resolution graphics capability. The graphics characters are formed on a 2x3 block grid and are available if colour characters 145 to 151 are used.

These graphics symbols can be displayed in contiguous mode, as shown in the table or in separated mode where there is a background colour boundary between and around the six cells of each symbol.

Separated mode is turned on with CHR$154 and contiguous mode returned to with CHR$153.

```
100 PRINT CHR$145CHR$154CHR$185CHR$153
   CHR$185
```

Another facility only available in graphics mode is to "hold" a graphics symbol. A control character is normally displayed as a space, thus there is usually a space between colour changes on any one line.

The control character for hold is CHR$158, and it allows an abrupt colour change by displaying a held character in the space where any control character occurs. This character is displayed in the mode holding for its position.

The held character is the last graphic symbol used, provided that no change has since occurred in the normal/double height or alphanumeric/graphic mode. A space is used if there has been no previous graphic symbol.

This mode is released with CHR$159.

```
100 PRINT CHR$146CHR$158CHR$185CHR$150
   CHR$186
```

Ascii codes for graphics characters

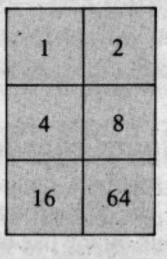
Pages 488-489 of the User's Guide show that the graphics symbols can be obtained with either of two Ascii codes. It is in fact easier to use the higher

→

TELETEXT MODE 7

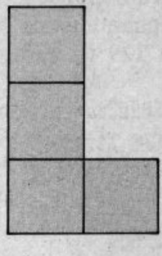
numbered set, starting at 160. The Ascii code for any particular symbol can be calculated simply by use of the method shown below.

Each graphic symbol consists of three rows of two dots. Each "on" dot can be represented by a number added on to 160. These numbers are shown below. They just represent individual "bits" of a byte



1	2
4	8
16	64

Thus the symbol:



is represented by the Ascii code 160+1+4+16+64=245.

Remember to always allow room in the display for all the control characters if you are mixing lots of effects. The moment a control character is overwritten it ceases to have any effect.

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BBC MICRO USER

Programmer's guide 2

MODE 7 COLOURS

TEXT NUMBER	COLOUR	GRAPHICS NUMBER
129	Red	145
130	Green	146
131	Yellow	147
132	Blue	148
133	Magenta	149
134	Cyan	150
135	White	151

BBC MICRO USER

Programmer's guide 3

MODE 7 CONTROLS

SPECIAL CODES

NUMBER	EFFECT
136	Flash foreground to background
137	Stop flashing
140	Normal height
141	Double height on
153	Return to continuous mode graphics
154	Turn on separated made graphics
156	Switch to black background
157	Set background to current foreground colour
158	Enable hold character
159	Release hold character

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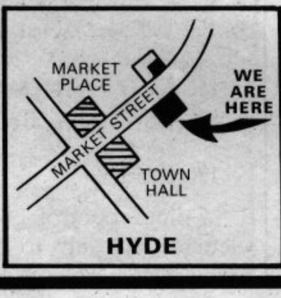

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Listings loopholes

Or how the fickle finger of fate foils your best endeavours

ONE of the good things about *BBC Micro User* is that it lists lots of programs that I couldn't have written for myself, and others that I didn't know I needed until I saw them in print.

Once I've seen a set of listings though, I'm the type who has to have them on tape just in case I ever need them. Believe it or not, I still have all the examples from the Users Guide!

Because of this obsession, I must have typed in hundreds of listings, and in the process I've made so many errors that I consider myself an expert on the subject. Here I am going to try to pass on some of the lessons I've had to learn the hard way.

Entering listings can be both time consuming and frustrating. You do your best to type in a perfect copy and it doesn't work.

The normal reaction is to blame the magazine, but, believe it or not, the odds are that it's you who's made the error – usually just a simple mistake, but one that can cause a lot of heartache until you find it.

The trouble is that some of them are experts in camouflage.

Quite a lot are simple copying mistakes, such as leaving out a line or typing in the wrong variable name. Here a lack of concentration and typing expertise combine to produce errors.

Another rich source of confusion comes from the BBC Micro allowing you to use both capital and lower case letters which, if confused, lead to problems which are surprisingly easy to overlook. ERROR ONE shows the sort of thing.

```
10 REM ERROR ONE
20 LET EILEEN=31
30 LET X=35
40 IF Eileen<35 THEN PRINT "Eligible"
```

I'm afraid the only way to reduce errors like these is to take time and trouble copying in the listing. Check the line before you press RETURN. I know it sounds horribly prim, but time and trouble taken at the beginning do reap rewards later.

Try to have at least a rough idea of what the program is supposed to do and try to understand the place of the line in the scheme of things. Ask yourself "What's happening now?" as you enter a line.

I call this active as opposed to passive copying, and while at first it takes some effort, it soon becomes second nature and pays the double dividend of making a boring job interesting and increasing your knowledge of Basic.

Having said that, it's surprisingly easy to daydream while copying in listings!

Next come two rather stupid errors for which I seem to have a great aptitude. The first is not clearing out old programs when typing in new listings. This can result in odd lines turning up in the middle of the program you're trying to copy, or, if your new listing is shorter than the program already in the machine, additional lines at the end.

The moral is, use NEW when you enter a new listing (and, of course, run the cassette bugs fix if you need to). ERROR TWO shows what can happen if you don't – line 45 is fairly obviously left over from a previous program.

```
10 REM ERROR TWO
20 LET EILEEN=31
30 LET X=35
40 IF EILEEN<35 THEN PRINT "Eligible"

45 IF Door$="OPEN" THEN PRINT "ENTER
AT YOUR PERIL"
```

The other stupid error is to use the AUTO command to set up the line numbers, then forget about it and type the numbers in anyway. A line number in your listing looking like 1010 or 2020 is a dead giveaway. (Notice also that the line 1010 is not treated as such by the micro, but as line 10.) Moral – if you use AUTO, don't forget it!

```
1010REM ERROR THREE
20LET EILEEN=31
3030 LET X=35
40IF EILEEN<35 THEN PRINT "Eligible"
```

Typing mistakes are another fruitful source of anguish. If you put in NAD instead of AND or PINT instead of PRINT, you haven't been paying attention to your typing, and more care is needed.

The BBC Micro will flag your errors, and they're fairly easily picked up by comparing the original with what you typed in. Try running ERROR FOUR to see this. (Incidentally, if you misspell a variable the micro will probably give you the message "no such variable".)

```
10 REM ERROR FOUR
20 LET EILEEN=31
30 LET X=35
40 IF EILEEN<X  THEN PINT "Eligible"
```

Some typing errors aren't so easy to spot. In fact they are masters of disguise, the Scarlet Pimpernels of the computer world. These are the look-alikes, the characters in the type set that are similar in appearance but mean vastly different things to the computer.

The classic error is to confuse zero, "0" which is a number, with "O", the letter of the alphabet. It's surprising how difficult this is to spot when you are copying in listings. It can lead to chaos when the program is run, or, rather, doesn't. ERROR FIVE should illustrate this.

```
10 REM ERROR FIVE
20 FOR X=1 TO 10
30 PRINT "YOU'VE CONFUSED 'O' AND
'0' "
40 NEXT
```

Similarly, there can be confusion between the number one, "1", and the lower case letter "l". These are used as the same thing on a typewriter, but are separate keys on the BBC Micro. Capital "I" also likes to get in on the mistaken identity act, especially when being used as a loop variable.

```
10 REM ERROR SIX
20 FOR X=1 TO 10
30 PRINT "YOU'VE CONFUSED '1' AND
'l' "
40 NEXT
```

The last masters of disguise are the fullstop ".", the semi-colon ";" and the comma ",". They are all close together on the keyboard. Given this and the fact that they look alike on poor quality listings, the conditions are ripe for a mistake to be made.

The results of an error in punctuation can vary from displays in the wrong place, through error messages, right the way to blank screens and hung programs.

Try messing about with the punctuation of a VDU statement and see what happens! My penchant is for missing out the semicolon from statements such as VDU 29;640;512; – it can cause a lot of problems.

If you want real trouble, mix up the punctuation in a data list. For example,

DATA 3,3.5,4,4.5

can become

DATA 3,3,5,4,4.5

If you mix up a decimal point and a comma this will, of course, result in the wrong data being read. At times this causes a very subtle form of confusion since, if the number of items in the list is increased, the BBC Micro won't flag an error.

All the previously mentioned faults are common but none are so common as the next, and final, class of errors. I call them the Space Invaders. They creep in easily and they can be the very devil to detect. No doubt you've been told that BBC Basic ignores extra spaces and so it does, but sadly there are some spaces it will not ignore. Usually these are in subscripts attached to keywords. For example it is

RND(123) not **RND (123)**

and

DIM B(12) not **DIM B (12).**

Also note that it is

X + 0.5 not **X+0. 5**

ERROR SEVEN demonstrates the idea.

```
   10 REM ERROR SEVEN
   20 PRINT TAB (10);"YOU'VE MADE A
SPACING ERROR"
   30 REM IT SHOULD BE TAB(10),NOT
TAB space(10)
```

As you probably know, BBC Basic allows keywords to be embedded in variables. That is, you can have variable names like GOODRUN and SHOPLIST, but you can't have the variable names starting with a keyword, so RUNNER and TOMATO are right out.

Of course, in a decent listing the variable names will be all right, but it is because the BBC Micro allows embedded keywords that another type of Space Invader error, almost the complete opposite of the earlier type, can occur. This is not too many spaces but too few.

It happens when you type a keyword immediately after a variable without leaving a space between them like:

15 IF BILL>MONEYTHEN PRINT "BROKE!"

The point here is that the micro, unconcerned about the embedded keyword, looks for a variable called MONEYTHEN, which will lead to an error. ERROR EIGHT demonstates the type.

```
10 REM ERROR EIGHT
20 LET HEA=3
30 LET X=2
40 IF  X<HEATHEN THEN PRINT" YOU'VE
RUN A VARIABLE AND A KEYWORD TOGETHER
TO MAKE A NEW VARIABLE NAME"
```

That concludes our review of some of the more common copying errors – all easy to fall into, but fairly simple to correct once you know what you are looking for.

As some of the error messages might not be what you expect, try running the examples so that you'll find fault tracing less confusing in practice. As an exercise, I've left you MISTAKE to try to debug – never was a program so aptly named!

I'm sure that you'll come across other errors that can occur while typing in listings – if so please write in and let me know, and I'll pass them on.

Finally if, after all this, your program doesn't work, remember it may not be you. I once spent hours on a program listing from a well-known book on the BBC Micro wondering why it didn't work. Eventually it dawned on me: The print colour was the same as the background!

Now take the bugs out of this

```
1010    REM MISTAKE
20    VDU 28,5.30,17;0
30    COLOUR  O
40     REM THIS PROGRAM ATTEMPTS TO
50     PRINT '1,2,3,4,5'
60     COLOUR 128
70 FOR 0=1 TO 5
80      Print TAB (9), O,".";
90      NEX
```

Part Two of MIKE BIBBY'S introduction to programming

Keep your CAPS on – and fall not into error!

THIS month we are going to begin to write our own programs. Nothing spectacular mind, but enough to give you a quiet glow of satisfaction. Firstly, let's discuss briefly what we did last month.

We learned that to "talk" to the computer we had to speak to it in a language it already understood, called Basic. We also learned how to get the BBC Micro to do sums for us and to print out messages, or strings as they are known.

One basic word we used quite frequently was PRINT, which instructs the micro to write or print things out on the screen. For instance, to do the sum 4+4 we typed

```
PRINT 4+4 [Return]
```

where [Return] means you should press the return key – this sends the message we have typed to the computer. Hopefully it then responds by printing the correct answer, 8.

Similarly, we could do subtraction, multiplication and division – the symbols for which are "–", "X" and "/" respectively. Notice particulary the division symbol. Although you can produce the "÷" symbol on the screen in Mode 7 (by pressing "~"), the BBC Micro does not interpret this as meaning division – you must use "/".

We also learned that to print out messages we had to surround them with quotes, as we do when recording speech. So, to print the message "GOOD MORNING" on the screen we type:

```
PRINT "GOOD MORNING" [Return]
```

which causes the message to be written on the screen. Now on the BBC Micro we can use lower case or small letters, so we can print "Good Morning" by using:

```
PRINT "Good Morning" [Return]
```

Notice that PRINT itself remains in capitals. This is because it is a special Basic word – a keyword. For the BBC Micro to realise that it has a special meaning, it must be written in capitals, as must all other Basic words. For the moment, keep Caps Lock on – this will prevent you from falling into this error.

So far we have given the computer one instruction at a time, which it carried out immediately after we pressed Return (assuming we'd typed it correctly).

Sometimes, though, we want to give the micro a series of instructions and then tell it to carry them out. for instance, suppose we want the message:

PROGRAMMING
IS
EASY

to appear on the screen. With our step-by-step method, we would have used:

```
PRINT "PROGRAMMING" [Return]
PRINT "IS" [Return]
PRINT "EASY" [Return]
```

But, as you'll see if you try it, this doesn't produce the required effect, since each successive instruction spoils the layout.

We need to give the computer the instructions so that it

1. Prints out PROGRAMMING
2. Prints out IS
3. Prints out EASY

in sequence, without stopping to ask us what to do next. Such a sequence of instructions is called a program. Notice also that the sequence is numbered – after all, the computer needs to know the order to carry them out in.

Now let's write a program to print out

PROGRAMMING
IS
EASY

We were on the right lines with the first attempt, but this time, let's try numbering our instructions as we enter them.

First of all, we shall enter Mode 6, a text-only mode with:

```
MODE 6 [Return]
```

Now type:

NEW [Return]

NEW is a Basic keyword that clears out the computer's memory. If you don't do this the program you are typing in might get jumbled up with a previous one – you'll see more clearly how this can happen later.

You probably think that you haven't got a program in at the moment, but use NEW anyway, because it is possible that you might have entered a line or two by chance.

Then type:

10 PRINT "PROGRAMMING" [Return]

Notice two things:

- The first instruction is number 10, not number 1. In computing we tend to number our instructions in steps of ten for reasons that will become blindingly obvious later. We call the number of an instruction its line number.
- The computer didn't immediately carry out the instruction – it didn't print out PROGRAMMING after we pressed Return. This is because of the line number. It tells the computer that what follows isn't to be done immediately but is to be remembered for later as it is just one in a series of instructions. I'll prove that the computer actually does remember it in a moment.

Now type:

20 PRINT "IS" [Return]
30 PRINT "EASY" [Return]

What I'm going to ask you to do next should test your faith in me! Clear the screen by typing:

L + [CTRL]

All your typing should have disappeared, but don't worry – your work hasn't been wasted. Because of the line numbers, the computer has kept a list of your instructions in its memory. To see the list, type:

LIST [Return]

and your program should reappear. We'll call it Program One:

```
10 PRINT "PROGRAMMING"
20 PRINT "IS"
30 PRINT "EASY"
```

If you have a problem don't worry – list your program and look for the lurking mistake

An important point coming up now. We have entered a program (a numbered sequence of Basic instructions) into the BBC Micro's memory and have got the computer to display those instructions with LIST. We have not, however, told the computer to do these instructions. It's like having written a shopping list – you still have to go out to the shops and turn your list into reality.

So to get the computer to actually do, or as we say, run the program in its memory, we type:

RUN [Return]

and, if we've typed it in properly, we should see printed out:

```
PROGRAMMING
IS
EASY
```

If you've managed it, congratulations on running your first program. (If not, don't worry, it's probably some simple error. List your program and look for the mistake. You might actually have a message telling you that there is an error in a particular line. What we're about to do next, although it assumes that you have been successful so far, will in fact show you how to correct your mistakes.)

Now let's try to alter our program so that it prints out:

```
PROGRAMMING
IS
SIMPLE
```

If you look back at the first program you will see that you need to alter line 30.

Changing line 30 couldn't be simpler – just type in the new line 30, remembering to start with the line number 30, then press Return. The latest version will replace the old version in the computer's memory.

To demonstrate this, type:

30 PRINT "SIMPLE" [Return]

and then:

LIST [Return]

You should obtain Program Two, which is:

```
10 PRINT "PROGRAMMING"
20 PRINT "IS"
30 PRINT "SIMPLE"
```

An examination of this listing should reveal that the new version of line 30 has indeed replaced the old one. (Notice also that we didn't give LIST a line number – we wanted the BBC Micro to do it immediately.)

As a final proof that our amendment has been accepted, type:

RUN [Return]

You should now get the revised message.

You can use this technique to correct mistakes in your programs. For example, if you accidentally typed line 10 as:

10 PINT "PROGRAMMING"

then, when you tried to run it you would get the message "Mistake at line 10". (Note that you don't receive this message when you first enter the line, only when you try to run it.)

To rectify such mistakes, simply retype the correct version of line 10 and press Return to enter it into the computer – the correct version will replace the faulty one.

There are more sophisticated ways of correcting, or editing, a line, but they can wait for a while. For the moment we

→

From Page 21

shall simply retype the line, with its line number, and press Return. Of course, if you notice a mistake while you are entering a line, use the delete key to erase it, then continue typing from that point.

So far I have given you just two programs to run. However, using these as models, you can print out virtually any message you want on the screen. Just use line numbers in increments of 10, each line printing out part of the message you want out on the screen, by enclosing it in quotes after PRINT.

An important point about this series is that I'm going to give you lots of example programs to type in. Virtually all of them have two things in common:

- The make vital teaching points (otherwise they wouldn't be there in the first place).
- The output – that is, what appears on the screen – is trivial in content and in many cases there are far easier ways of doing it.

Programming is a skill like driving – you can only improve by doing it, not reading about it. Please carry out the examples, however silly or obvious they may seem to you.

Also, and this is far more important, I want you to go beyond the programs – try to alter, adapt and extend them, just to see what happens.

Adopt an experimental approach and a healthy scepticism for my pronouncements. if you are wondering whether something will work, go ahead and try it – you can't hurt the computer from the keyboard, so let your imagination run riot.

You'll learn far more from your own examples than you will by merely echoing mine. And the good thing is that you get such prompt feedback from a computer. If what you write isn't acceptable you'll soon get a mistake or error message.

So what I'd like you to do now is to spend a good time writing simple "message" programs for the computer to run. For some reason, in my experience in computing classes the messages tend to become quite scurrilous. There's one thing I've never been too sure of – is it slander or libel when it appears on a VDU?

Remember, type NEW before each new program, and use line numbers for each instruction. It's also good policy to LIST your program before you RUN it, just to make sure that all is as you intend.

Now suppose we wanted to alter Program Two so that it printed out the message:

PROGRAMMING
IS
RATHER
SIMPLE

We need a line in there between 20 and 30 to print out "RATHER". Well, 25 is a number between 20 and 30, so let's try:

25 PRINT "RATHER" [Return]

If you list it you'll see that the program has now become Program Three:

```
10 PRINT "PROGRAMMING"
20 PRINT "IS"
25 PRINT "RATHER"
30 PRINT "SIMPLE"
```

So line 25 has "crept in" between 20 and 30. Even though we entered it out of order, the BBC Microcomputer stores it in memory in its correct numerical position. Try running the program as final confirmation.

This ability to insert lines into programs is the reason our line numbers go up in steps of 10 when we are writing programs – it leaves us plenty of spare line numbers in between for when we are patching them up.

Now enter Program Four:

```
10 CLS
20 PRINT "BBC"
30 PRINT "MICRO"
40 PRINT "USER"
```

remembering to press return after typing each line.

Now LIST it. Is there a phantom line 25 in there? If so, you didn't type NEW after the last program – the lines 10, 20 and 30 of the latest program have replaced those lines in the old program. But as the new program doesn't have a line 25, the old one remains to ruin your program. The moral is to use NEW before entering a new program.

If you have got an unwanted line 25, don't worry – you can easily get rid of it by typing:

25 [Return]

This will delete the line since you replace the old line 25 with a new line which contains nothing – which the computer then "forgets". This method holds good for deleting any line from a program – simply type out the line number, then press Return.

Now Program Four contains the keyword CLS, which, as you shall see when you run the program, clears the screen.

If when you run the program, the top line seems to be missing, you can adjust the picture by typing:

*TV 255 [Return]

Before this takes effect you must change mode – in this case we wish to remain in Mode 6 so we type:

MODE 6 [Return]

This should take care of the problem.

Now let's try to print out our message with blank lines between. We can use a line containing just PRINT to obtain a blank line, so program Five should do the trick:

```
10 CLS
15 PRINT
20 PRINT "BBC"
25 PRINT
30 PRINT "MICRO"
35 PRINT
40 PRINT "USER"
```

Alternatively, we can use an apostrophe at the end of the PRINT line to force the computer to "skip" a line. Program Six demonstrates this:

```
10 CLS
20 PRINT "BBC" '
30 PRINT "MICRO" '
40 PRINT "USER"
```

We can use apostrophes to create new lines before the string as well. program Seven shows this:

```
10 CLS
20 PRINT ' ' "BBC"
30 PRINT ' ' "MICRO"
40 PRINT ' ' "USER"
```

Actually we can achieve the whole of the above printing on one line with program Eight:

```
10 CLS
20 PRINT ''"BBC"''"MICRO"''"USER"
```

Line 20 makes sense if you think about it! Now try Program Nine:

```
10 CLS
20 PRINT "HELLO";
30 PRINT "OUT";
40 PRINT "THERE"
```

The output you will get is:

HELLOOUTTHERE

i.e. each successive string is printed after the preceeding one. The semicolon stops the next string being printed on a new line, "gluing" it to the end of the previous string printed.

Notice that, since there are no spaces inside the strings, none appear between the words when they are printed out together.

Try to get the message to appear legibly by rewriting the program with appropriate spaces in the strings. Also notice that you can obtain the same output, far more simply, with Program Ten:

```
10 CLS
20 PRINT "HELLO OUT THERE"
```

However, as I said above, the programs I present to you are for making teaching points, which does not necessarily imply showing you the most efficient methods.

Experiment with joining up the output of successive PRINT statements with the use of the semicolon until you feel confident about it.

And now for something completely different. Try running Program Eleven:

```
10 PRINT "I "
20 PRINT "FEEL"
30 PRINT"DIZZY"'''
40 GOTO 10
```

I think the effect is pretty impressive. So far all our programs have merely copied back onto the screen what you have typed in. This program shows how, with the addition of one line (line 40), you can obtain a huge increase in the amount of output. It is this ability, to repeat a simple operation rapidly, that gives the BBC Micro much of its power.

If things are happening a little too fast for you, you can temporarily halt proceedings by holding down CTRL and SHIFT together. When you release them things will continue at their normal rate.

What is happening is that the computer follows lines 10, 20 and 30 and prints out:

```
I      (line 10)
FEEL   (line 20)
DIZZY  (line 30)
```

followed by three blank lines due to the apostrophes. It then encounters line 40, which tells it to go back to line 10. It duly does so and prints out:

```
I      (line 10)
FEEL   (line 20)
```

etc., until it reaches line 40, when it goes back to line 10 and so on ad infinitum. Notice that when the screen is full, it scrolls up to make more room.

Now the name for such a condition in a program, where you keep on repeating lines of code (as the program lines are known), is a loop.

We say here that we are in an unconditional loop because we haven't given the program any conditions for it to cease repeating itself. This is bad programming practice – compulsively introspective computers are not useful machines!

To stop such unconditional loops, you have to interrupt them from "outside" by either pressing the ESCAPE or BREAK key. Of the two, ESCAPE is to be preferred – you can compare it to stopping a car with the brakes. Using the BREAK key is more akin to stopping your car by driving it into a wall.

BREAK won't actually damage your computer, but it will cause you to return to the state of the computer on switch on, which is Mode 7, and with no program in when you LIST. (You can actually recover the program with OLD, but now we're getting ahead of ourselves.) Always use ESCAPE if you can.

If you want to have some fun with an unconditional loop, try printing out repeatedly an arrow composed of asterisks such as:

```
   *
  ***
 *****
*******
  ***
  ***
  ***
  ***
```

which will scroll upwards off the screen.

Finally, apart from its being an unconditional loop, which is always naughty, can you see what else is going wrong with this program?

```
10 CLS
20 PRINT "THIS IS "
30 PRINT "VERY SILLY"
40 GOTO 10
```

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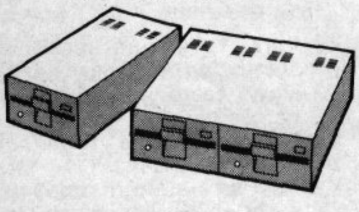

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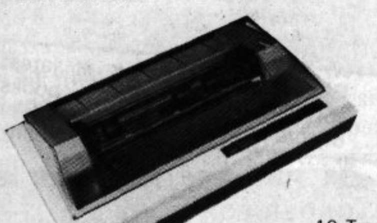

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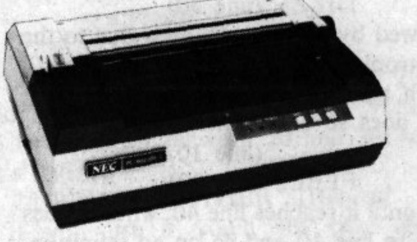

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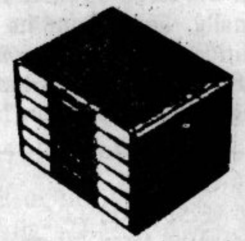

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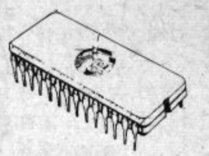

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Your micro can keep tabs on the temperature and log the lights

By MIKE SHAW

BY using very simple circuits and relatively cheap components it is possible to use the BBC Micro to measure temperature and light intensity, producing graphical displays of the results.

The idea is based on the use of the potential divider circuit, dealt with in last month's article, or a bridge circuit, to measure the varying output of a transducer.

In the case of light, a simple transducer would be a light dependent resistor, such as the ORP12, widely available and costing approximately £1. Such a resistor is included in the potential divider circuit shown in Figure I.

In the dark the resistance of the ORP12 is very high, and consequently the voltage Vout is very low and can be detected using the ADVAL command.

As the intensity of the light falling on the ORP12 increases, the resistance falls and Vout increases. When this voltage is applied to the ADC (analogue to digital converter), the ADVAL function will return the proportionate number.

The resistors A and B serve to bring Vout into the range that the ADC can accept, which is 0 to 1.8 volts.

Fairly large values for A and B are chosen so that the ADC draws very little current from the circuit. By making the fixed resistors variable it is possible to alter the sensitivity of the circuit over various light intensity ranges.

Program I demonstrates the use of the circuit to determine light levels. Vout is connected to pin 15 of the ADC. The program allows up to 1,000 readings to be taken very quickly and then displayed in a graphical form. Using the program, it is possible to see how the light from a bulb increases when it is switched on – the ramping effect.

A thermistor is needed to measure temperature. The type of thermistor used will depend on the temperature range it is desired to investigate. The readily obtainable miniature bead variety can measure temperature over the range −10 to 100 degrees centigrade. Such a device can be incor-

→

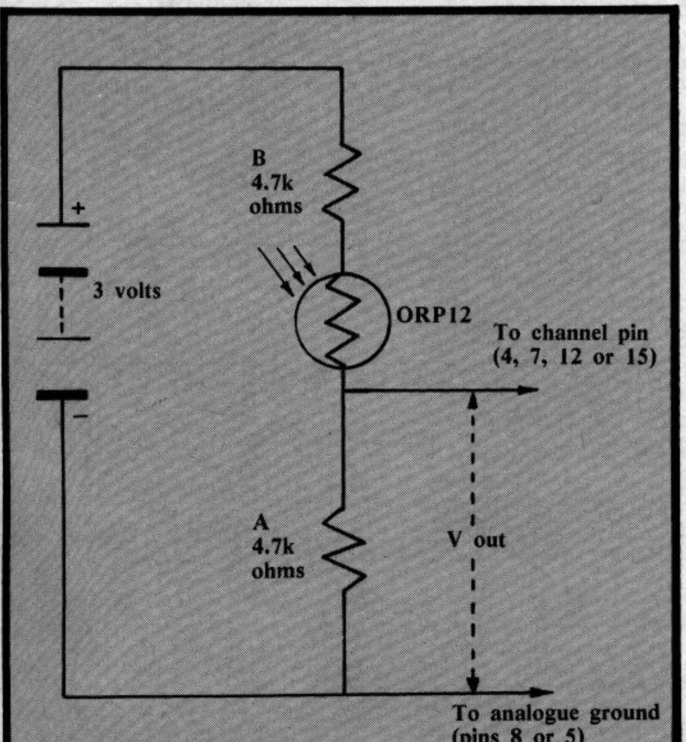

Figure I

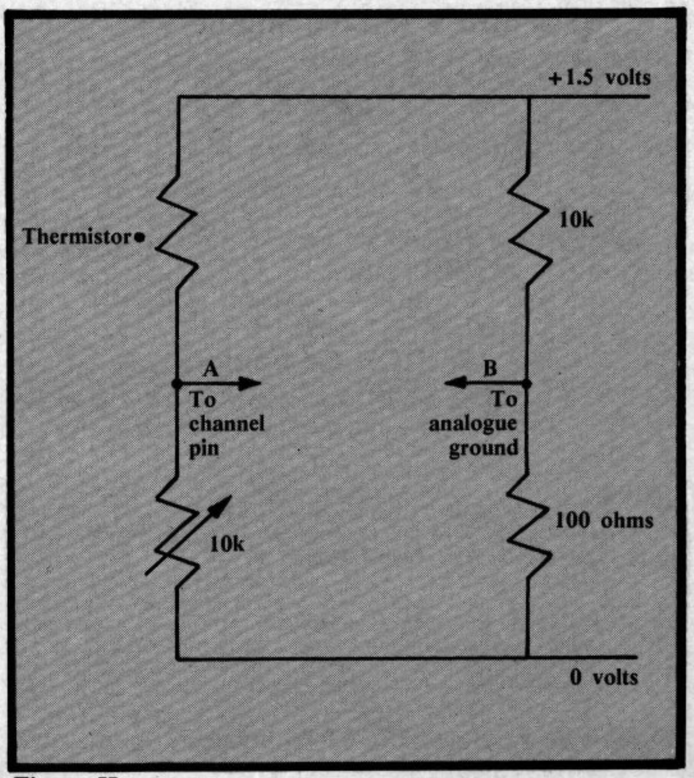

Figure II

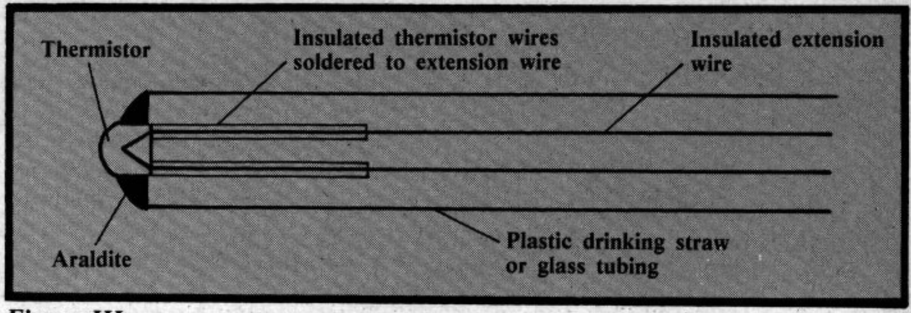
Thermistor
Insulated thermistor wires soldered to extension wire
Insulated extension wire
Araldite
Plastic drinking straw or glass tubing

Figure III

porated in a bridge circuit, as shown in Figure II.

The ADC actually measures the difference in potential between the two arms of the bridge. This potential difference is determined by the resistance of the thermistor, which varies proportionally with the temperature.

The variable resistor may be adjusted so that the ADVAL reading gives 0 when the temperature is 0 degrees centigrade. The lead from A should be connected to the correct channel pin, and the lead from B to analogue ground.

Unless it is only intended to measure air temperature, the thermistor will need to be made into a probe. This can be done as shown in Figure III.

As the thermistor's resistance has a linear relationship with temperature, it is possible to calibrate it using ice at 0 degrees centigrade and water at 100 degrees centigrade.

For example, if the ADVAL reading given at 100 degrees centigrade is called TEMPMAX, then any other temperature can be found by using

**TEMPERATURE=ADVAL/
TEMPMAX * 100**

For more accurate temperature measurement it would be necessary to know the exact relationship between resistance and temperature. This varies between thermistor types.

Quite often all that is needed is to be able to note when the temperature increases or decreases during an experiment, rather than knowing the exact temperature.

In Program II changes in light intensity and temperature can be obtained and plotted graphically together. The TIME function is used so that it is possible to take readings from one second upwards.

Lines 110 to 130 set the scaling factor for the plotting procedure, and it may be necessary to adjust these for your own probe.

In next month's article I will look at how to take readings from colorimeters, pH meters and sound meters.

Turn to Page 87

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GRAPHICS

LAST month we saw how we could use the COLOUR statement to obtain text in different colours on the screen. We also used the TAB( ) statement to good effect without describing exactly how it functions.

Now, although we did not make it explicit, all these operations took place on the TEXT screen. To put it simply, if not totally accurately, you can use the screen of your television either for writing, when we say we are using the text screen, or for drawing pictures and suchlike, when we say we are using the graphics screen.

The graphics screen has its own special set of commands entirely different from those we learnt for the text screen.

You can mix the text and graphics screens – they can overlap or occupy entirely separate areas or "windows" of the screen. In fact when you enter modes capable of supporting graphics, the text and graphics screens initially coincide – you can print text or draw graphics over the entire area of the VDU.

To avoid the schizophrenia that this may induce, for the moment we shall consider the screens in isolation, and not attempt to mix text and graphics.

Before describing the graphics screen, which takes up the bulk of this article, let's formalise our ideas about the text screen.

In all eight modes of the BBC Micro we can print characters to the screen. The maximum number of characters on the screen at one time varies from mode to mode.

MODES 6 and **7,** text only modes, support 25 lines of 40 characters.

MODES 1 and **4** support 32 lines of 40 characters.

MODES 2 and **5** support 32 lines of 20 characters.

MODE 0 supports 32 lines of 80 characters.

MODE 3, a text only mode, supports 25 lines of 80 characters.

We can consider each character to be occupying one cell of the screen, different modes having different numbers of cells. Now the TAB (X,Y) function uses a type of coordinate system to allow us to print in specific cells. Figure I illustrates the coordinate system available in MODE 4.

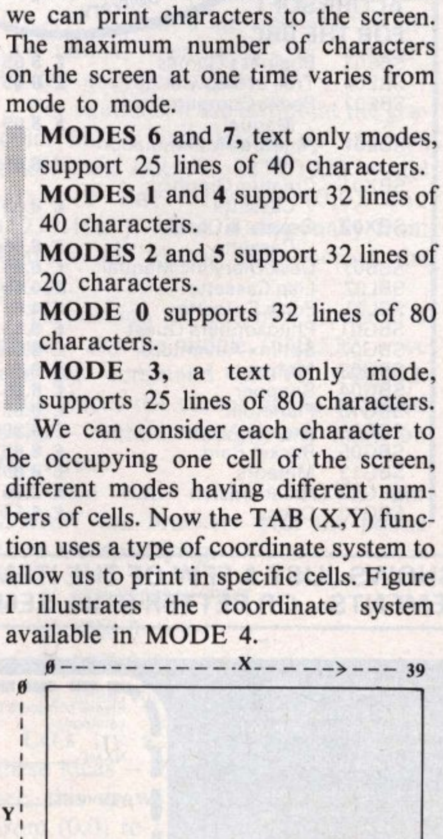

Figure I: Text screen in Mode 4

Notice two points:

- The origin – point (0,0) – is at the top left of the screen. Y increases as it goes downwards.
- Although there are 40 cells for characters across each line, they are numbered 0 to 39. Similarly, down the Y-axis, the range for the 32 lines is from 0 to 31.

Of course in the other modes the values for the X and Y ranges will differ, since the number of character cells differ. The above two points still hold, though.

```
10 REM *** PROGRAM ONE ***
20 MODE 5
30 FOR position=0 TO 19
40 PRINT TAB(position,position)"*"
50 NEXT position
```

Program I illustrates a simple use of the TAB( ) function by drawing a line of asterisks diagonally across the screen. Try altering the mode in line 20 to modes 4, 6 and 0 to see the effect on the output. Remember, the meaning of the coordinates varies from mode to mode because of the differing number of cells available. You might also try altering the program so that the diagonal runs from right to left.

```
10 REM *** PROGRAM TWO ***
20 MODE 5
30 FOR position=0 TO 19
40 PRINT TAB(position,position)"*"
50 NEXT position
60 FOR position=0 TO 19
70 PRINTTAB(19-position,position)"*"
80NEXT position
```

Program II draws an 'X' of asterisks using two loops, one for each diagonal. Can you adapt it so that only one loop is used? Also the 'X' is not central – try to rectify this.

```
10 REM *** PROGRAM THREE ***
20 MODE 5
30 centre=9:top=7:bottom=25
40 FOR row=1 TO 9
50 start=centre- row +1
60 FOR length = 0 TO 2*(row-1)
70 PRINT TAB( start+length, top+row);
"*"
80 PRINT TAB(start+length,bottom-row)
;"*"
90 NEXT length
100 NEXT row
110 VDU 30
```

Program III uses nested loops to draw a diamond of asterisks on the screen. See if you can follow the logic, then try adding the following versions of line 65. Can you visualise the effects accurately before you run them?

65 COLOUR (start + length) MOD 3+1

65 COLOUR (top + row) MOD 3 + 1

Incidentally, the VDU 30 on the last line simply returns the cursor to the top

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left of the screen to stop it spoiling our pattern.

```
  10 REM *** PROGRAM FOUR ***
  20 MODE 5
  30 VDU 19,3,4,0,0,0:VDU 19,0,2,0,0,0
  40 COLOUR 128:CLS
  50 centre=9:top=7:bottom=25
  60 FOR row=1 TO 9
  70 start=centre- row +1
  80 FOR length = 0 TO 2*(row-1)
  90 COLOUR(ABS(start+length-9)+ABS(top
+row-16))MOD3+129
 100 PRINT TAB(start+length,  top+row);
" "
 110 PRINT TAB(start+length,bottom-row)
;" "
 120 NEXT length
 130 NEXT row
 140 VDU 30
```

Program IV uses virtually the same technique to produce a rather striking pattern. Here, instead of asterisks, spaces are used, so the colours which vary are the background colours. We also use VDU 19 to reassign the background colours.

Line 90, which ensures that the choice of colours is symmetrical, is far more complex than the lines we added to Program III.

Now let's have a look at the graphics screen. There is no complicated way of "entering" the graphics screen – when you enter a mode the whole of the screen is available for graphics, as it is for text, of course. We shall concentrate on the former.

Actually, the ground we're going to cover is fairly simple – we are going to learn to draw lines in various colours. The command for drawing lines is DRAW and the command to change colours is GCOL, which stands for "graphics colours". The statement COLOUR is used for text colours only.

Firstly, let's consider the coordinate system for the graphics screen, as shown in Figure II.

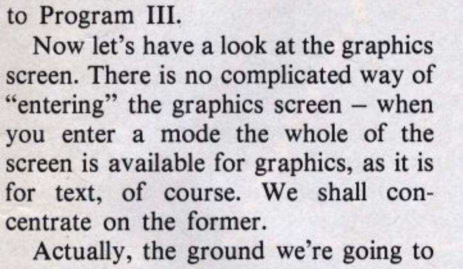
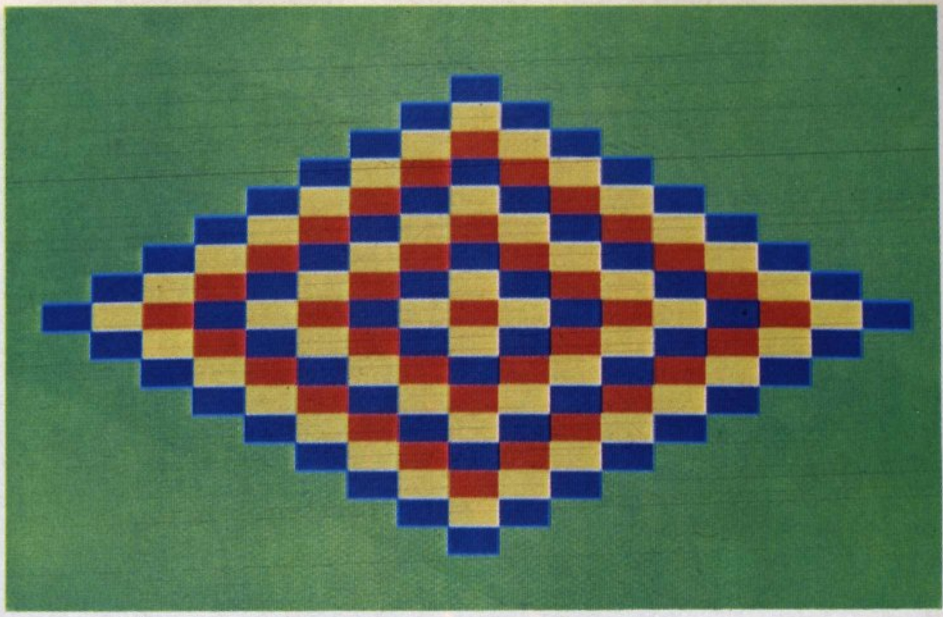


Figure II Graphics Screen

Note the following:

- The origin – point (0,0) – is at the bottom left-hand corner of the screen. Y increases as it goes upwards.
- The "cells" of the coordinate system range from 0 to 1279 along the X-axis (horizontally) and 0 to 1023 along the Y-axis (vertically). Each is measured in "graphic units" (gu).



Program IV

- When you change modes (assuming that you pick a mode capable of supporting graphics), the physical positions of the points don't change. That is, (0,0) will still be at the bottom left-hand corner of the screen, (1279,1023) at the top right, and (640,512) at the centre of the screen.

Let's try drawing some lines on the screen. To do this we imagine something called the graphics cursor, which is invisible yet occupies a specific point on the screen. We use the command DRAW to draw a line between the last two points "mentioned", or "visited" by the graphics cursor.

For example, if the last point the graphics cursor had "ended up" at was (0,0), then DRAW 1279,1023 would draw a line between (0,0) and (1279,1023), which is diagonally from bottom left to top right across the screen.

To position the graphics cursor at a point – say the middle, (640,512) – we use the command MOVE 640,512. This places the cursor at the specified point – without making any mark on the screen.

Notice that neither MOVE nor DRAW use brackets with the points they are specifying.

```
   10 REM PROGRAM FIVE
   20 MODE 5
   30 MOVE 0,0
   40 DRAW 1000,1000
```

Let's try a simple program using these ideas – Program V. As you can see, this draws a simple diagonal line from (0,0) to (1000,1000).

Now try drawing it with the additional line

```
   50 DRAW 1000,0
```

This draws a line vertically down to (1000,0), a point on the X-axis. Remember, DRAW connects the last point the cursor visited – in this case (1000,1000) from line 40 – to the point specified in the DRAW command, which in this case is (1000,0).

Perhaps you can see how

```
   60 DRAW 0,0
```

will complete a triangle by drawing a horizontal line to the origin.

The following completes the square and adds the second diagonal:

```
   70 DRAW 0,1000
   80 DRAW 1000,1000
   90 MOVE 0,1000:DRAW 1000,0
```

The final outline is shown in figure III. Note the MOVE necessary in line 90. I think that it is impossible to obtain the screen shown in Figure III by using just DRAW without using MOVE or going over the same line twice. Is there anyone out there who can prove me wrong – or at least prove me right?

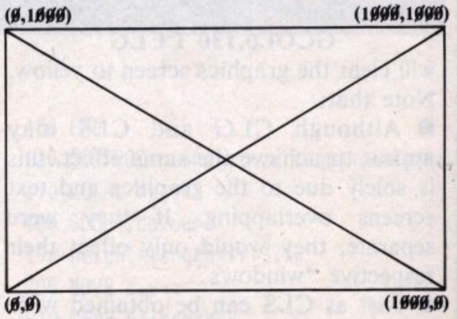


Figure III: Figure produced by Program V

Before abandoning Program V, try it in MODE 4. There are two things to notice here:

- When you change mode, the position of the triangle does not alter on the screen – graphics points are fixed.
- The lines drawn on the screen are much finer than in MODE 5.

The latter is because MODE 4 has "higher resolution" than MODE 5. That is, it works to a finer "grid" or, if you like, it draws with a finer pen. MODE 4 can fit in more characters per line than MODE 5 because of this "fineness" or higher resolution. In a particular graphic mode the fewer characters per line it can support, the coarser it draws its graphic lines, which means the lower its resolution.

So while changing modes may not cause our picture to be drawn in different positions, it certainly effects the detail available.

Now to change the colour of the lines we use the GCOL statement. In MODE 5, assuming we haven't changed the logical colour assignments with VDU 19:

GCOL0,1 will cause future lines to be drawn in red.

GCOL0,2 gives yellow lines.

GCOL0,3 gives white lines.

GCOL0,4 gives black lines.

We say that GCOL0 changes the graphics foreground colour to the logical colour specified after the comma. At the moment we are going to treat the command as if it were always

GCOL0,

followed by a logical colour number. In fact, as we shall learn, we can use numbers other than zero before the comma.

Being able to define a graphics foreground colour suggests that we should be able to define a background colour. This works in very much the way it did for text colour – to define a background colour we use GCOL0, with the logical colour number we want as background PLUS 128. For example, GCOL0,129 will give us a red background in MODE 5 (assuming the standard colour assignments).

Just as we used CLS to clear the screen to the background colour while using the text screen, so we use CLG to obtain the same effect on the graphics screen. Thus

GCOL0,130 : CLG

will clear the graphics screen to yellow. Note that:

- Although CLG and CLS may appear to achieve the same effect, this is solely due to the graphics and text screens overlapping. If they were separate, they would only effect their respective "windows".
- Just as CLS can be obtained with

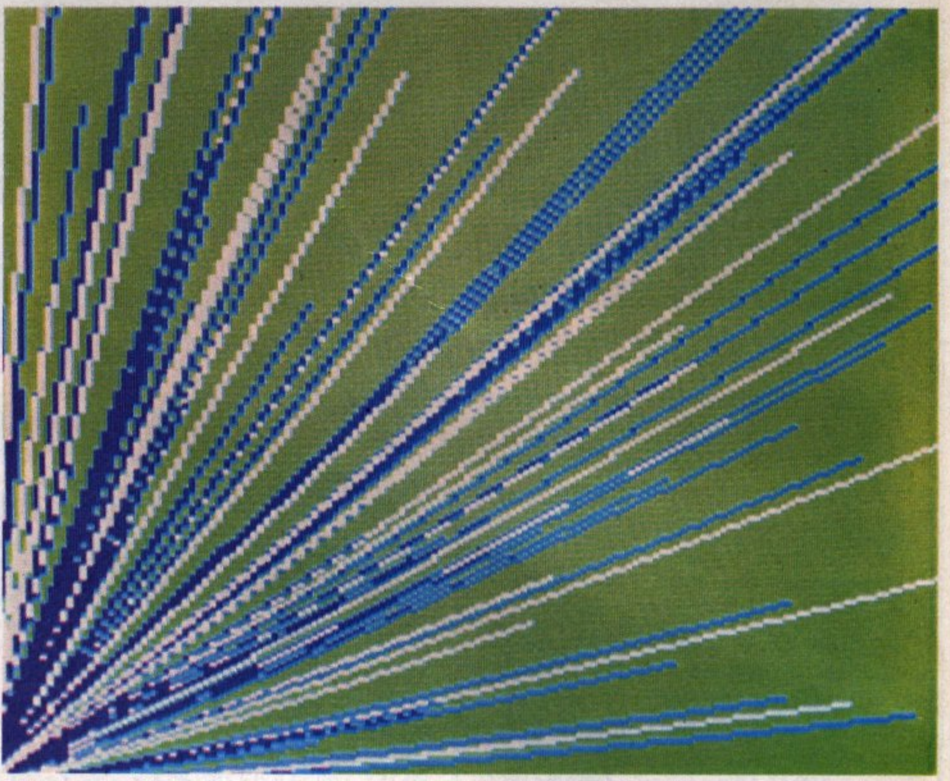
L + [CTRL]

so CLG can be obtained with

P + [CTRL]

Program VI shows the final version of the last program with graphics colours added. Try giving it a nicer colour scheme!

```
10 REM PROGRAM SIX
20 MODE 5
30 VDU 19,0,5,0,0,0:VDU 19,3,4,0,0,0
40 GCOL0,128:CLG
50 GCOL0,1
60 MOVE 0,0
70 DRAW 1000,1000
80 GCOL0,2
90 DRAW 1000,0
100 DRAW 0,0
110 DRAW 0,1000
120 DRAW 1000,1000
130 GCOL0,3
140 MOVE 0,1000:DRAW 1000,0
```



Program VIII

Program VII should demonstrate amply the difference between CLG and CLS – lines 40 and 50 set up different background colours for them to clear to. Press 'S' to stop the program.

```
10 REM PROGRAM SEVEN
20 MODE 5
30 REPEAT
40 COLOUR 129
50 GCOL0,130
60 CLS
70 A$=GET$
80 CLG
90 A$=GET$
100 UNTIL A$="S"
```

Program VIII uses all the above techniques to produce a "sunburst" of colour from the origin. It draws 100 lines of random colour to random points on the screen.

```
10 REM PROGRAM EIGHT
20 MODE 5
30 VDU 19,0,5,0,0,0:VDU 19,3,4,0,0,0
40 count=0
50 REPEAT
60 count=count+1
70 MOVE 0,0
80 x=RND(1279):y=RND(1023)
90 GCOL0,RND(3)
100 DRAW x,y
110 UNTIL count > 99
```

Try adding all, or random combinations of the following lines to the program:

```
105 MOVE 1279,0:DRAW x,y
106 MOVE 1279,1023:DRAW x,y
107 MOVE 0,1023:DRAW x,y
```

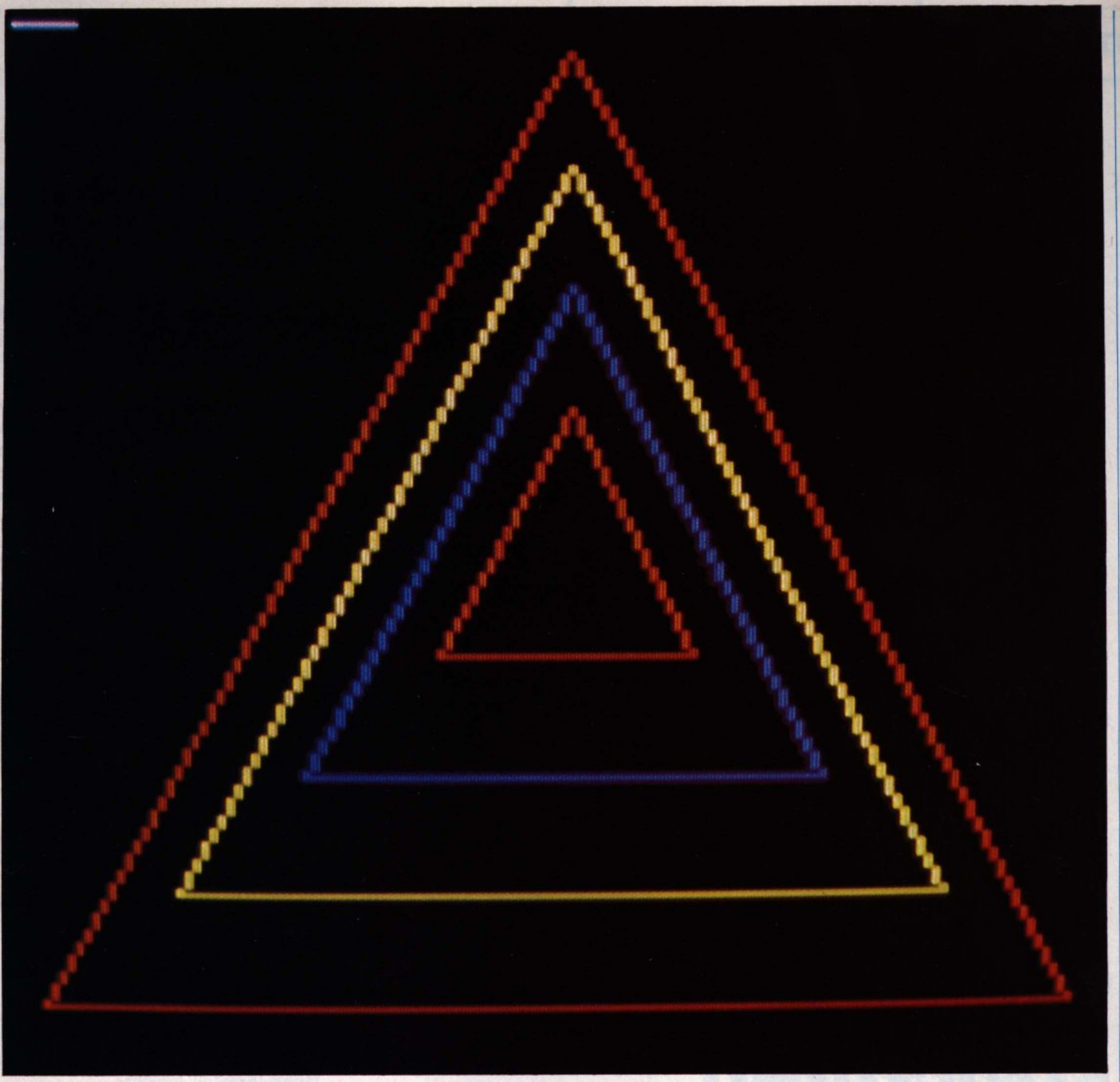
Can you predict the outcome before running it?

Another variation is to alter the assignment of logical colours in the sunburst after it has been drawn. For this add:

```
120 REPEAT
130 A=RND(4)-1:B=RND(7)
140 VDU 19,A,B,0,0,0
150 FOR I=1 TO 2000:NEXT I
160 UNTIL FALSE
```

Program IX plots a series of random triangles over the screen, using a simple procedure PROCtriangle that produces an equilateral triangle using MOVE and DRAW.

```
10 REM PROGRAM NINE
20 MODE 5
30 VDU 19,3,4,0,0,0
40 TALLY=0
50 REPEAT
60 XPOS=RND(1000):YPOS=RND(800)
70 SIZE=RND(500)
80 PROCtriangle(XPOS,YPOS,SIZE,TALLY
MOD 3+1)
90 TALLY=TALLY+1
100 UNTIL TALLY = 50
110 END
120 DEFPROCtriangle(x,y,length,colour)
130 LOCAL height
140 GCOL0,colour
150 height=length*1.732/2
160 MOVE x,y
```



Program X

```
  170 DRAW x+length,y
  180 DRAW x+length/2,y+height
  190 DRAW x,y
  200 ENDPROC
```

Figure IV should make the workings of this procedure clearer. The actual values of x,y and length are passed to the procedure in line 80 as XPOS, YPOS and SIZE respectively, which have been determined randomly.

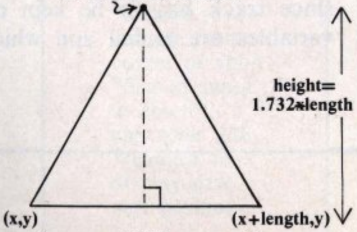


Figure IV

Program X then uses exactly the same procedure to nest three equilateral triangles within a fourth.

```
   10 REM PROGRAM TEN
   20 MODE 5
   30 VDU 19,3,4,0,0,0
   40 TALLY=0
   50 SIZE=1000
   60 HEIGHT=1.732*SIZE/2
   70 REPEAT
   80 BASE=SIZE - TALLY*250
   90 UP=HEIGHT*TALLY/4
  100 XPOS=100 + 250*TALLY/2
  110 YPOS=UP/2  + 100
  120 PROCtriangle(XPOS,YPOS,BASE,TALLY
MOD 3+1)
  130 TALLY=TALLY+1
  140 UNTIL TALLY > 3
  150 END
  160 DEFPROCtriangle(x,y,length,colour)
  170 LOCAL height
  180 GCOL0,colour
  190 height=length*1.732/2
  200 MOVE x,y
  210 DRAW x+length,y
  220 DRAW x+length/2,y+height
  230 DRAW x,y
  240 ENDPROC
```

To consolidate this month's work, you might like to define a procedure for drawing a rectangle – by defining two corners, or alternately using one corner, length and breadth. Then, as in program IX, use this procedure to draw random rectangles on the screen.

Finally, as in Program X, try nesting the rectangles within one another.

Take the NIMble approach to structured programs

– advises SEAN OVEREND

THE object of NIM is to make your opponent take the last of a random number of objects ("nimbers"), which are arranged in piles ("rows").

You and your opponent take it in turns to remove nimbers, any amount from any one row at each turn. If you're forced to take the last you've lost.

In this version of NIM your opponent is the BBC Micro itself. The fundamental line of the program is line 2200 – this holds the rather complex algorithm needed to implement the game.

All too often such a central "problem" tends to dominate a programmer's design approach so much that his initial energy is devoted to solving it. The rest of the program grows up by default, to the detriment of the program's quality.

There is, however, another method particularly suited to the BBC Micro which is termed "structured" and is generally considered to produce better programs.

Taking NIM as an example, let's see how these contrasting approaches effect the process of program design:

A NIM-playing program must

(i) Display the current board position.
(ii) Accept moves from the player.
(iii) Generate the computer's moves.
(iv) Work out the winner and keep track of the scores.

One way to program the game would be to take each of these basic components, encode them, and then string them all together.

This is programming "from the bottom up", and is inevitable to a degree where the version of Basic available is limited to GOTOs and GOSUBs.

While judicious use of CASE-type statements like ON NN GOTO/GOSUB can go some way towards reducing spaghetti-logic, there are bound to be difficulties in lengthy programs.

The passing of information to often-used subroutines can also be tedious, since track has to be kept of which variables are global and which local, and which are treated as the general parameters.

Using BBC Basic, however, it is possible to approach the task in quite the reverse direction, programming "from the top down." This facility results almost entirely from the provision of procedure calls in the language.

For those with high level language experience (I go back to ALGOL '68!), it is a provision hitherto sadly missed in micros.

Procedures can be thought of as either untyped (the BBC PROC), or typed (the BBC FN). Untyped procedures perform the tasks within them; typed procedures also return a value through the procedure (FN) name. Either sort can be with or without parameters.

With imagination, the names given to the procedures can make life easier for the programmer and more comprehensible for those who have to read his program.

Line 1870 is a good example of the use of a Boolean-type procedure call, where the value of FNnotwinnable is being used to determine whether or not certain other action is taken.

Let us now consider a structured approach to the NIM program. it will have to do the following:

(i) Set up its own internal variables.
(ii) Display instructions to the player.
(iii) Play the game, repeatedly if necessary.
(iv) Exit.

Each of these tasks will be controlled by a procedure, which can be named at the outset even though the raw program has not yet been written. Thus the first lines of the program to be written are:

```
10 PROCinitialise
20 PROCdisplayinstructions
30 REPEAT PROCplaygame: UNTIL
   tired
40 PROCexitroutine
50 END
```

Each of these individual procedures is then programmed in terms of its own constituents, which can either be "raw program" or further procedure calls. Eventually the basic components will be reached, and duplication may be cut down by programming general purpose procedures, such as PROCdoubleprint, which is used while in Teletext mode.

In the result, the central line 2200 is not programmed first, with everything else dependent upon it. It is not programmed until FNnotwinnable is reached, a procedure called by (and programmed subsequently to) PROCinputmine, a procedure called by PROCtaketurns, a procedure called by PROCplaygame. (The general structure of the playing part of PROCplaygame is set out in Figure 1).

In a nutshell, structured programming is all about the dog wagging its tail, and not vice versa!

Some comments on the program:

- Lines 5, 25, 35 – MODE changes are not possible inside procedures.
- There are two versions built into this program, one for black/white output (using flashing highlight techniques), and the other in colour. Experiment to improve on them.
- There is also plenty of scope for alternative sounds when the end of a game is reached (lines 2630, 2633).
- Real gluttons can convert the program to run in MODE 7, substituting ordinary characters instead of the special screen characters, and inserting the appropriate control characters in the screen lines in lieu of the COLOUR statements.

You will need to know that the vertical tabbing of the display is set by the choice of 16 in line 1020. The horizontal tab of 5 occurs in lines 1060, 1290, 1330, 1430, 1470, 1900.

The maximum boardsize can be increased to 10 by altering lines 730 and 760, without the need to alter either the NIM declaration or FNnotwinnable.

NIM LISTING STARTS ON PAGE 89

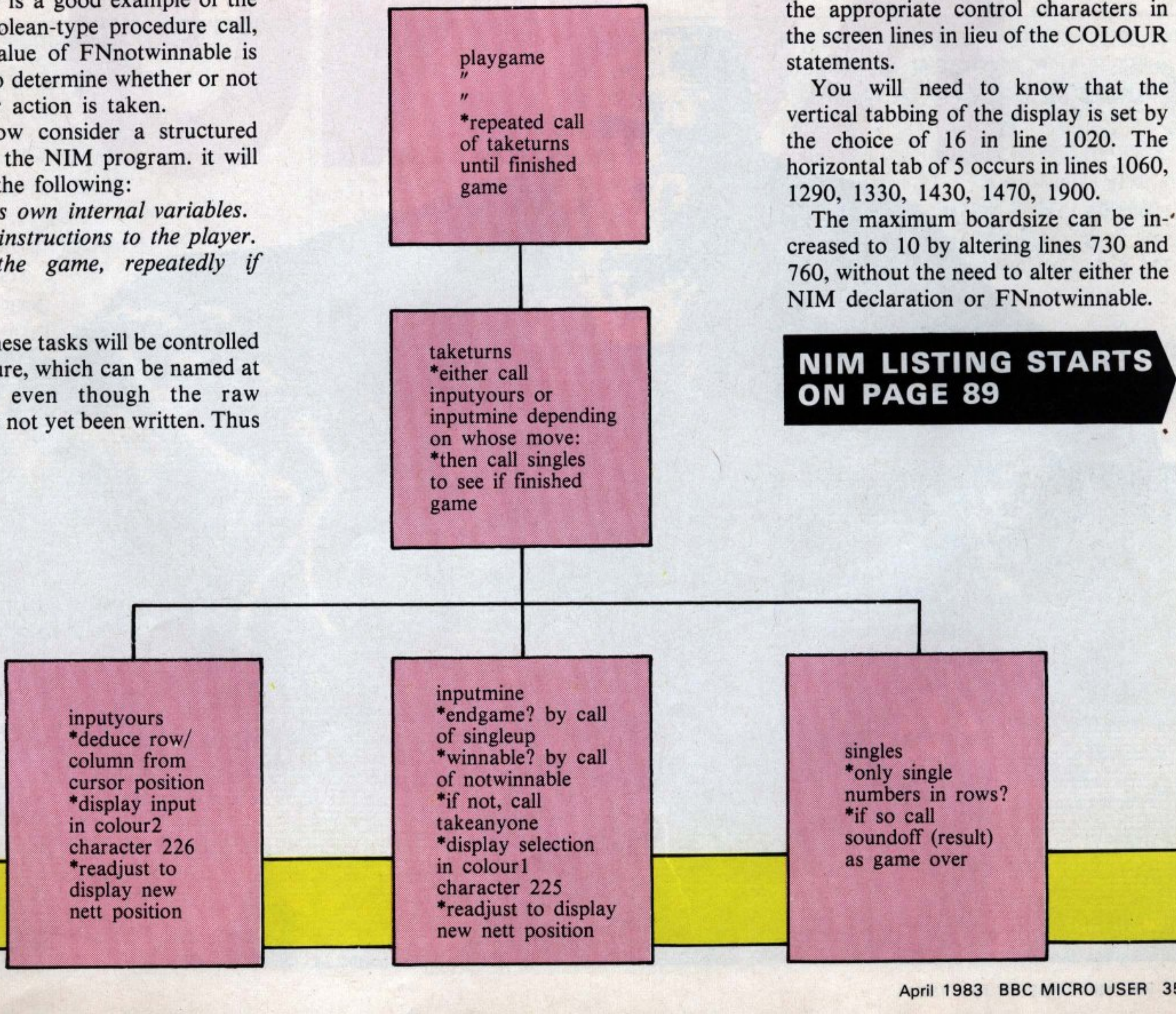
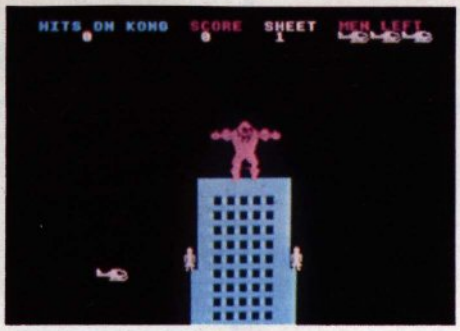

playgame
"
"
*repeated call of taketurns until finished game
taketurns
*either call inputyours or inputmine depending on whose move:
*then call singles to see if finished game
inputyours
*deduce row/ column from cursor position
*display input in colour2 character 226
*readjust to display new nett position
inputmine
*endgame? by call of singleup
*winnable? by call of notwinnable
*if not, call takeanyone
*display selection in colour1 character 225
*readjust to display new nett position
singles
*only single numbers in rows?
*if so call soundoff (result) as game over

Figure I

KING KONG



KING Kong is a reasonably simple game. All you have to do is to use your helicopter to rescue the two girls perched on the side of the building, land them on the ground, and kill King Kong. When you have done that, you progress to the next attempt.

You kill King Kong by hitting him 40 times with your machine guns. If you kill Kong before having rescued both girls from the building, the game ends. The game also ends if you crash into one of the girls.

You lose a life if you are hit by one of the rocks which Kong throws down from his perch. You lose another if you crash into the skyscraper. To pick up one of the girls you simply position the helicopter just above her head. The BBC Micro will beep when you have done this. You land the girls by moving your helicopter to the screen bottom.

The key commands are:

A move the helicopter up.

B move the helicopter down.

SHIFT moves it forwards

SPACE BAR reverses the direction of the helicopter.

RETURN fires the machine guns.

One point worth noting is that in line 10 the value of DIF1% sets the difficulty that you start at. If you find the game too easy change this so that DIF1%=2 – you won't get so far then! (The reason for the value listed is that our geriatric editor couldn't do better than zero on the original value of two!)

The program itself is fairly structured.

Lines 1-70 initialise everything and draw the scenery.

Lines 80-160 comprise the main loop of the program. PROCcheck is called from this loop.

PROCinit initialises VDUs and variables. PROCkong draws King Kong on the screen.

PROCwin draws windows in the skyscraper.

PROCskysc draws the skyscraper, calling PROCwin.

PROCheli draws the helicopter pointing right if FR%=+16 otherwise it draws the helicopter pointing left. If PICK%=1 a girl is drawn under the helicopter.

PROCcheck checks to see what keys have been pressed:

If SHIFT is pressed the helicopter is reversed, the value in FR% being inverted.

If RETURN is pressed PROCfire is called.

If Z is pressed 16 is subtracted from the helicopter's vertical position, then PROCcrashcheck, PROCpickup and PROCdrop are all called.

If A is pressed 16 is added to the helicopter's vertical position. PROCcrashcheck is called.

If SHIFT is pressed, the value of FR% (either +16 or –16) is added onto the horizontal position of the helicopter. PROCcrashcheck and PROCpickup are called.

PROCfire draws the machine-gun fire and calls PROChitcheck. PROCscoreboard prints along the top of the screen the number of helicopter "lives" you have, the hits on Kong, the sheet you are on and your score.

PROCcrashcheck checks to see if you have crashed into the skyscraper or Kong. If so, it calls PROCexplosion, which draws the explosion, decreases the number of helicopters you have by one, calling PROCgameover if the result is zero.

PROCfanfare plays the opening tune.

PROCsetup calls PROCskysc, PROCkong and draws the two girls on the skyscraper.

PROClogic is the logic routine that aims Kong's throws and PROCthrow moves Kong's arm and calls PROClogic.

PROCpickup calls game over if you have crashed into one of the girls. If not it checks to see if you have picked her up, beeping and drawing her under your helicopter if you have.

PROCdrop checks to see if you have landed one of the girls, beeping and drawing her at the bottom if so.

PROCnextsheet checks to see if you have qualified to go onto the next sheet – you have to have 40 hits on Kong and have rescued both girls. If so, it changes the background colour and increases the difficulty. If you've hit Kong forty times, but haven't rescued the girls, it calls PROCgameover.

PROCgameover plays the ending tune and calls PROCscores, which checks to see if you have achieved a high score. If so it asks for your name, entering it together with your score into the relevant place in the high-score table, which displays the ten highest scores.

PROCinstructions displays the instructions.

```
    1 ONERRORGOTO50
   10 DIF1%=1
   20 MODE1
   30 *FX15,1
   40 PROCinit
   50 PROCinstructions
   60 PROCscoreboard
   70 PROCsetup:PROCfanfare
   80 PROCheli
   90 PROCthrow
  100 Q%=Q%+H%:W%=W%+V%:MOVEQ%,W%:GCOL4,
0:VDU241
  110 PROCcheck
  120 IFW%<=Y%+30ANDW%>=Y%-30ANDQ%>=X%AN
DQ%<=X%+90THENPROCexplosion
  130 IFFLAG=1THENFLAG=0:CLS:LOOP%=1:GOT
O60
  140 MOVEQ%,W%:GCOL4,0:VDU241
  150 LOOP%=LOOP%+1
  160 IFLOOP%>14THENLOOP%=1:GOTO90ELSEGO
TO100
  170 DEFPROCinit:VDU23,224,0,0,1,3,7,27
,123,253,23,225,253,253,255,255,127,127,
63,63,23,226,31,31,31,15,15,15,31,31,23,
227,63,63,127,127,127,63,63,127,23,228,2
54,254,126,126,62,62,126,241,23,229,120,
252,254,223,72,132,215,171
  180 VDU23,230,254,50,133,153,123,183,2
55,255,23,231,255,255,255,255,255,255,25
5,255,23,232,255,207,135,3,000,0,0,23,23
3,1,1,1,0,0,0,0,0,23,234,0,0,0,0,128,96,
120,252,2,235,2$$252,24,28,248,240,2
40
  190 VDU23,236,224,224,224,192,192,192,
224,224,23,237,240,240,248,248,248,240,2
40,248,23,238,252,252,248,248,240,240,12
0,64,23,239,60,126,255,255,255,255,126,2
8,23,240,0,16,60,255,255,255,62,0,23,241
,0,8,60,255,255,255,124,0
  200 VDU23,242,24,60,60,24,60,255,189,1
89,23,243,189,189,60,126,255,36,36,102
  210 VDU23,244,192,224,224,255,255,0,0,
0,23,245,31,62,254,254,255,63,16,127,23,
246,192,56,4,4,248,226,132,248,23,247,1,
14,16,16,15,67,33,31,23,248,248,60,63,63
,255,254,8,254,23,249,3,7,7,255,255,0,0,
0,23,250,0,112,248,252,126,15,7,3
  220 VDU23,251,0,14,31,63,126,240,224,1
92
  230 PROCcinit:VDU23;8202;0;0;0:CLS
  240 SHEET%=1:MEN%=3:SCORE%=0:DIF%=DIF1
%:COL%=0:X%=200:Y%=300:FR%=+16:HITKONG%=
0:PICK%=0:LGIRL%=1:RGIRL%=1:DIMHISCORE%(
9):DIMHISCORE$(9):FORL%=0TO9:HISCORE%(L%
)=1000:HISCORE$(L%)="BBC computer":NEXT
  250 FLAG=0:FLAG1=0:R%=0:LOOP%=1:CLS
  260 ENDPROC
  270 DEFPROCkong:GCOL0,2:VDU224,229,234
,10,8,8,8,225,230,235,10,8,8,8,226,231,2
36,10,8,8,8,227,232,237,10,8,8,8,228,233
,238:MOVE540,ARM%:VDU241,239:MOVE690,ARM
%:VDU239,240:ENDPROC
  280 DEFPROCwin(A%,B%):GCOL0,0:MOVEA%,B
%:MOVEA%+20,B%:PLOT85,A%,B%-20:PLOT85,A%
+20,B%-20:ENDPROC
  290 DEFPROCskysc:LOCALL%:GCOL0,1:MOVE4
80,0:MOVE800,0:PLOT85,480,300:PLOT85,800
,300:MOVE500,300:MOVE780,300:PLOT85,500,
450:PLOT85,780,450:PLOT85,500,550:PLOT85
,780,550
  300 FORL%=20TO520STEP40:PROCwin(550,L%
):PROCwin(590,L%):PROCwin(630,L%):PROCwi
n(670,L%):PROCwin(710,L%):NEXT:ENDPROC
  310 DEFPROCheli:GCOL4,0:*FX15,0
  320 IFFR%=-16THENMOVEX%,Y%:VDU247,248,
249ELSEIFFR%=16THENMOVEX%,Y%:VDU244,245,
246
  330 IFPICK%=1THENMOVEX%+30,Y%-30:VDU24
2,10,8,243
  340 ENDPROC
  350 DEFPROCcheck:IFINKEY$(0)=" "PROChe
li:FR%=(-FR%):PROCheli:ENDPROC
  360 IFINKEY(-74)PROCfire:ENDPROC
  370 IFINKEY(-98)ANDY%>100THENPROCheli:
Y%=Y%-16:PROCheli:PROCcrashcheck:PROCpic
kup:PROCdrop:ENDPROC
  380 IFINKEY(-66)ANDY%<900THENPROCheli:
Y%=Y%+16:PROCheli:PROCcrashcheck:ENDPROC
  390 IFINKEY(-1)ANDX%+FR%<1200ANDX%+FR%
>0THENPROCheli:X%=X%+FR%:PROCheli:PROCcr
ashcheck:PROCpickup:ENDPROC
  400 ENDPROC
  410 DEFPROCfire:GCOL4,0:IFFR%=16:MOVEX
%+90,Y%-15:DRAWX%+270,Y%-15:FORL%=1TO3:S
OUND0,-15,4,2.5:SOUND0,0,0,.6:NEXTL%:GCO
L4,0:DRAWX%+90,Y%-15:PROChitcheck:ENDPRO
C
```

→

```
  420 MOVEX%,Y%-15:DRAWX%-180,-15:FORL%=
1TO3:SOUND0,-15,4,2.5:SOUND0,0,0,.6:NEXT
L%:GCOL4,0:DRAWX%,Y%-15:PROChitcheck:END
PROC
  430 DEFPROCscoreboard:VDU4:COLOUR1:PRI
NTTAB(1,1);"HITS ON KONG":COLOUR2:PRINTT
AB(15,1);"SCORE":COLOUR3:PRINTTAB(22,1);
"SHEET":COLOUR2:PRINTTAB(29,1);"MEN LEFT
":COLOUR3:PRINTTAB(5,2);HITKONG%:PRINTTA
B(16,2);SCORE%:PRINTTAB(23,2);SHEET%
  440 PRINTTAB(29,2);:FORL%=1TOMEN%:VDU2
44,245,246;:NEXT:VDU5:ENDPROC
  450 DEFPROChitcheck:IFY%<651ANDY%>599T
HEN
  100 AELSEIFY%<695ANDY%>650THEN480ELSEE
NDPROC
  460 IFFR%=16ANDX%+90<590ANDX%+270>=590
THENHITKONG%=HITKONG%+1:SCORE%=SCORE%+20
:PROCupdatescore:PROCchnextsheet:ENDPROC
  470 IFFR%=-16ANDX%>720ANDX%-180<=720TH
ENHITKONG%=HITKONG%+1:SCORE%=SCORE%+20:P
ROCupdatescore:PROCchnextsheet:ENDPROC E
LSEENDPROC
  480 IFFR%=16ANDX%+90<560ANDX%+270>=560
THENHITKONG%=HITKONG%+1:SCORE%=SCORE%+20
:PROCupdatescore:PROCchnextsheet:ENDPROC
  490 IFFR%=-16ANDX%>750ANDX%-180<=750TH
ENHITKONG%=HITKONG%+1:SCORE%=SCORE%+20:P
ROCupdatescore:PROCchnextsheet:ENDPROC E
LSEENDPROC
  500 DEFPROCupdatescore:VDU4:COLOUR3:PR
INTTAB(5,2);HITKONG%:PRINTTAB(16,2);SCOR
E%:VDU5:ENDPROC
  510 DEFPROCcrashcheck:IFY%<310ANDX%>39
0ANDX%<800THENPROCexplosion
  520 IFY%<550ANDX%>410ANDX%<780THENPROC
explosion
  530 IFY%>550ANDY%<731ANDX%>500ANDX%<71
0THENPROCexplosion
  540 ENDPROC
  550 DEFPROCfanfare:RESTORE560:FORI%=0T
013:READM1,M2:SOUND1,-15,M1,M2:SOUND2,-1
5,M1+48,M2:SOUND3,-15,M1+96,M2:SOUND&100
1,0,0,0:NEXT:VDU4:PRINTTAB(18,5);"READY!
":FORI%=1TO4000:NEXT:PRINTTAB(18,5);"
   ":VDU5:ENDPROC
  560 DATA53,4,69,4,81,4,69,4,73,4,61,4.
69,8,53,4,41,4,25,4,41,4,33,4,49,4,53,8
  570 DEFPROCexplosion:VDU19,0,14,0,0,0:
SOUND0,-13,4,30:FORL%=1TO50:GCOL0,2:MOVE
X%+45,Y%-15:DRAW(X%-50)+RND(130),(Y%+50)
-RND(130):NEXT:MEN%=MEN%-1:VDU19,0,COL%,
0,0,0
  580 IFMEN%=0:PROCgameover:ENDPROC ELSE
X%=200:Y%=300:FR%=16:RGIRL%=1:LGIRL%=1:P
ICK%=0:FLAG=1:ENDPROC
  590 DEFPROCsetup:PROCskysc:ARM%=680:MO
VE600,700:PROCkong:GCOL0,3:MOVE460,360:V
DU242,10,8,243:MOVE790,360:VDU242,10,8,2
43:ENDPROC
  600 DEFPROClogic:IFX%>604THENH%=((X%-7
10)/20)*DIF%:V%=((Y%-680)/20)*DIF%:Q%=71
0:W%=680:ENDPROC ELSEH%=((X%-520)/20)*DI
F%:V%=((Y%-680)/20)*DIF%:Q%=540:W%=680:E
NDPROC
  610 DEFPROCthrow:IFX%<600THENGCOL0,0:M
OVE540,680:VDU241:GCOL0,2:MOVE540,690:VD
U250:PROClogic:TIME=0:REPEATUNTILTIME>4:
GCOL0,0:MOVE540,690:VDU250:GCOL0,2:MOVE5
40,680:VDU241:ENDPROC
  620 GCOL0,0:MOVE720,680:VDU240:GCOL0,2
:MOVE720,690:VDU251:PROClogic:TIME=0:REP
EATUNTILTIME>7:GCOL0,0:MOVE720,690:VDU25
1:GCOL0,2:MOVE720,680:VDU240:ENDPROC
  630 DEFPROCpickup:IFY%<300ANDY%>390THE
NENDPROC ELSEIFX%+90<470ORX%>810THENENDP
ROC ELSEIFY%<360ANDX%+90<510ANDLGIRL%=1O
RY%<360ANDX%>600ANDRGIRL%=1THENPROCgameo
ver:ENDPROC
  640 IFX%+90<510ANDLGIRL%=1ANDY%>360AND
Y%<395THENGCOL4,0:MOVE460,360:VDU242,10,
8,243:PICK%=1:LGIRL%=0:SOUND1,-15,101,2:
GCOL0,3:MOVEX%+30,Y%-30:VDU242,10,8,243:
SCORE%=SCORE%+200:PROCupdatescore:ENDPRO
C
  650 IFRGIRL%=1ANDX%>600ANDY%>360ANDY%<
395THENGCOL4,0:MOVE790,360:VDU242,10,8,2
43:PICK%=1:RGIRL%=0:SOUND1,-15,101,2:GCO
L0,3:MOVEX%+30,Y%-30:VDU242,10,8,243:SCO
RE%=SCORE%+200:PROCupdatescore:ENDPROC E
LSEENDPROC
  660 DEFPROCdrop:IFPICK%=0ORY%>120ORPIC
K%=0ANDY%>120THENENDPROC ELSEPICK%=0:SOU
ND1,-15,101,2:SCORE%=SCORE%+300:PROCupda
tescore:ENDPROC
  670 DEFPROCchnextsheet:IFHITKONG%<40TH
ENENDPROC ELSEIFLGIRL%=1ORRGIRL%=1THENPR
OCgameover:ENDPROC ELSEIFHITKONG%>39THEN
SHEET%=SHEET%+1:DIF%=DIF%+1:COL%=COL%+1:
X%=200:Y%=300:FR%=16:HITKONG%=0:LGIRL%=1
:RGIRL%=1:PICK%=0:VDU19,0,COL%,0,0,0
  680 CLS:IFSHEET%=5THENDIF%=DIF1%:COL%=
0
  690 FORL%=1TOSHEET%-1:ARM%=-20+(150*L%
):MOVE600,150*L%:PROCkong:MOVE750,-60+(1
50*L%):PRINT(25*L%);"Metres":NEXT
  700 MOVE300,900:PRINT"HOW HIGH CAN YOU
 GET?":FORnote%=53TO101STEP4:SOUND1,-15,
note%,5:NEXT
  710 TIME=0:REPEATUNTILTIME>200:FLAG=1:
ENDPROC
  720 DEFPROCgameover:VDU4:COLOUR3:RESTO
RE750:FORL%=1TO9:READ MES$:PRINTTAB(14+L
%,5);MES$:TIME=0:REPEATUNTILTIME>50:NEXT
:COLOUR2:PRINTTAB(14,7);"Hard luck!!"
  730 RESTORE760:FORI%=0TO17:READM1,M2:S
OUND1,-15,M1,M2:SOUND2,-15,M1+48,M2:SOUN
D3,-15,M1+96,M2:SOUND&1001,0,0,0:NEXT
  740 TIME=0:REPEATUNTILTIME>200:PROCsco
res:ENDPROC
  750 DATAG,A,M,E," ",O,V,E,R
  760 DATA81,4,77,4,81,4,61,4,81,4,77,4,
81,4,61,4,33,4,33,4,41,4,41,4,49,8,49,4.
49,4,41,4,41,4,33,16
  770 DEFPROCscores:CLS:VDU19,0.6,0,0,0,
19,2,0,0,0,0,19,1,7,0,0,0,4:L%=-1:REPEAT
:L%=L%+1:UNTILL%=9ORSCORE%>HISCORE%(L%)
  780 *FX15,1
  790 IFSCORE%<=HISCORE%(L%)THENGOTO810E
LSEZ%=9:REPEAT:HISCORE%(Z%)=HISCORE%(Z%-
1):HISCORE$(Z%)=HISCORE$(Z%-1):Z%=Z%-1:U
NTILZ%=L%
  800 PRINTTAB(3,5);"YOUR SCORE OF ";SCO
RE%;" WAS RANKED NO.";L%+1:PRINTTAB(3,7)
;:INPUT"YOUR NAME?"NAME$:HISCORE$(L%)=NA
ME$:HISCORE%(L%)=SCORE%
  810 CLS:VDU5:PROCsetup:GCOL0,2:MOVE224
,1023:PRINT"  KING KONG HALL OF FAME":MO
VE224,991:PRINT"========================
="
  820 FORL%=0TO9:IFL%=9THENGAP$=" "ELSEG
AP$="  "
  830 MOVE96,(959-(L%*32)*2):PRINT"NO.";
L%+1;GAP$;HISCORE%(L%);".........";HISCO
RE$(L%):NEXT
  840 MOVE160,96:PRINT"PRESS ESCAPE FOR
INSTRUCTIONS"'"     PRESS ANY OTHER KEY
TO START":REPEATUNTILGET>-1
  850 CLS:PROCcinit:SCORE%=0:HITKONG%=0:
SHEET%=1:MEN%=3:X%=200:Y%=300:PICK%=0:LG
IRL%=1:RGIRL%=1:COL%=0:DIF%=DIF1%:FR%=16
:FLAG=1:PROClogic:ENDPROC
  860 DEFPROCinstructions:CLS:VDU4:PROCc
init:COLOUR1:PRINTTAB(7,1);"KING KONG IN
STRUCTIONS":PRINTTAB(6,2);"=============
============":COLOUR2
  870 PRINT''" The game king kong is rea
lly quite     simple.All you have to do
is rescue the two girls perched on the b
uilding,land  them on the ground and kil
l king kong.  When you have done this yo
u progress    onto the next sheet."
  880 PRINT'" You kill kong by hitting h
im 40 times  with your machine guns.If y
ou kill kong before you have rescued bot
h girls from the building the game ends.
The game alsoends if you crash into one
of the girls."
  890 PRINT'"Press any key to continue":
REPEATUNTILGET>-1:CLS
  900 PRINT''" You lose a life if you ar
e hit by a    rock which kong throws dow
n from his    perch.You also lose a life
 when you     crash into the skyscraper.
You pick one  of the girls up by placing
 your         helicopter above her head.
"
  910 PRINT"The computer will beep when
you have    done this.You land one of th
e girls by  moving your helicopter to th
e bottom of the screen."
  920 PRINT'"    KEYS:"'" A..........MOV
ES HELICOPTER UP"'" Z..........MOVES HEL
ICOPTER DOWN"'" SHIFT......MOVES HELICOP
TER FORWARDS"'" SPACE BAR..REVERSES HELI
COPTER"'" RETURN.....FIRES MACHINE GUN"
  930 PRINT''"Press any key to play":REP
EATUNTILGET>-1
  940 VDU5:SHEET%=1:MEN%=3:SCORE%=0:DIF%
=DIF1%:COL%=0:X%=200:Y%=300:FR%=+16:HITK
ONG%=0:PICK%=0:LGIRL%=1:RGIRL%=1:CLS:END
PROC
  950 DEFPROCcinit:VDU19,0,0,0,0,0,19,1,
6,0,0,0,19,2,5,0,0,0,19,3,7,0,0,0:ENDPRO
C
```

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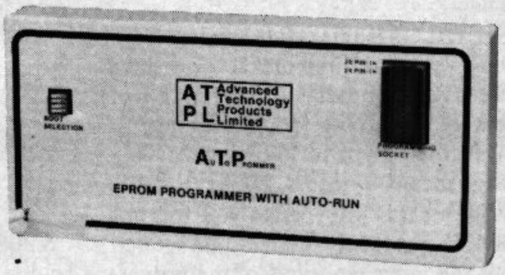
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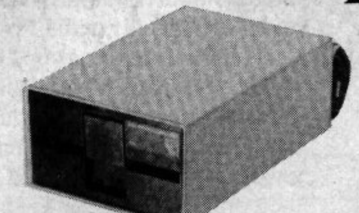

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This is the second of a series of articles dealing with the workings of the operating system of the BBC microcomputer. Last month PAUL BEVERLEY considered in simple terms its overall architecture and explained what the operating system is, why it is needed and the difference between the different versions of the operating system.

Take an indirect the middle

I SHALL assume that apart from having read the first article you have some very basic knowledge of assembly language programming, if only to the extent of knowing vaguely what is meant by LDA, STA, JSR etc.

Without this knowledge you will not really be able to understand much about the inner workings of the operating system, and in any case if you are content to work in Basic and aren't interested in using a second processor then you won't need to know about all this anyway.

Before going into detail I shall need to explain about an idea which may be new to some of you but which is important to an understanding and appreciation of the importance of the operating system.

Indirection vectors

If you look at the list of operating system routines given in Figure 1 you will see that most of the routines start with what is known as an indirect jump, such as JMP (&021C).

In fact, even those which apparently do not do so (OSASCI and OSNEWL) use calls to &FFEE which itself starts with an indirect jump. These addresses in page &200 are referred to as the indirection vectors.

What this means is that if you say, for example, "JSR &FFEE" in order to send a character to the screen and/or the printer and/or the RS423 serial port, the processor goes to &FFEE and finds "JMP (&20E)" and so looks at memory locations &20E and &20F to find the address of the actual routine which outputs the character.

When the system powers up, or on a BREAK, the operating system sets the values of the vectors to point to the appropriate routines in the operating system ROM, but because these pointers are held in RAM they can be changed by the user.

If, for example, you wanted to write your own specialised printer routine, all you would have to do would be to change the contents of &20E and &20F to point to the start address of your routine, and then at the end of your printer routine, jump to the address that was pointed to by the original contents of &20E and &20F.

You can probably now see why we talk about "indirection vectors". Vectors are things which show direction or "point", and so we say that &20E and &20F point to the character output routine. Then, although the routine you are using is in ROM, the processor does not go directly to it from &FFEE but rather it goes *indirectly* via a RAM location.

File systems

Probably the most important application of these vectors is in the use of file systems.

As you no doubt know, the BBC microcomputer can provide access to a number of file systems for the storage and retrieval of programs and data.

The two most obvious ones are cassette tape and disc but it is also possible to have programs and data stored in ROMs or EPROMs, within the computer itself or in the form of a cartridge ROM.

If the computer has an Econet interface you can link up to a network and load and save from a file-server system somewhere else on the Econet system.

When you say, for example, SAVE "PROG", it does not matter which file system you are using as the operating system takes care of that.

This means that you don't have to bother with using the different commands, CSAVE and DSAVE, for cassette and disc as you do in some other versions of Basic.

Whether you are using tape, disc, network or ROM file systems, whenever you LOAD or SAVE a file or GET or PUT bytes, Basic still apparently calls the same routines.

What happens is that when you type in *TAPE, *DISC, *NET or *ROM, all the appropriate vectors are changed to point to the routines for the selected file system.

If you have a disc system you can see this for yourself if you look at one of the vectors by typing in PRINT (!&21C AND &FFFF), then change file systems with *TAPE and look at the same vector again.

If you have access to an Econet system you can try the same with *NET.

In each case you will find that the vector has been changed to point to a different set of routines in the operating system.

If you try this with *ROM, you will find that the vectors are the same as for *TAPE. This is because it is a serial system, as is the cassette system, and so the routines need only minor changes which are dealt with by changing the values of certain flags in the operating system workspace.

Software compatibility

The other reason for using these vectors is that it makes all software which faithfully uses them entirely compatible with future upgrades of operating system.

You don't have the infuriating problem that you do with some other machines that when the manufacturers produce a new version of Basic you find that half of your software has to be modified because it uses different memory locations from the previous versions.

This also applies to using the same software with a second processor. Provided you have stuck faithfully to using the operating system routines

---

Paul Beverley is lecturer in electronics at Norwich City College.

jump right into of things ..

you should not need to change any of your software to make it run on the second processor.

Another kind of indirection

There is another kind of indirection which is provided within BBC Basic, the provision of which is something of a paradox.

Although the indirection facilities are superior to those provided in any other version of Basic that I know of, we are actually advised not to use them. I am referring to byte, word and string indirection.

Byte indirection is what in other versions is referred to as PEEK and POKE. The BBC version is much neater and more logically set out than using PEEK and POKE, and is extended further by providing word (four byte) indirection and string indirection.

Before I say why we are not supposed to use them, let me explain what they do.

If you say B=1200 then you are assigning the value 1200 to the variable named B, but if you then say ?B=100, what the Basic interpreter does is to look at the value of the variable B (=1200) and then put the value 100 into the memory location with that address. i.e. 100 is put into location 1200 (=&4B0 which should be one of the bytes of one of the resident integer variables, so no harm should be done if you try it.)

Thus ?B could be read as, "THE CONTENTS OF memory location B". You can interpret ?B in the same way in the expression, PRINT ?B which means "print the value of THE CONTENTS OF memory location B".

!B and $B are similar to ?B. !B (word indirection) means, "THE CONTENTS OF the four bytes starting from memory location B". This is interpreted as a four byte number, lowest byte to highest byte in that order.

Then $B (string indirection), not to be confused with B$ which is just an ordinary string variable, means, "THE CONTENTS OF the bytes starting from memory location B up to the next carriage return (&0D) character, interpreted as a string."

Communication via the operating system

What then constitutes a legal or an illegal operation as far as the operating system is concerned?

The diagram shown in figure 2 is an attempt to picture the various methods of communication within the computer and to the outside world. The legal moves are shown by double width arrows and the illegal ones by single arrows.

Basically, what you must do if you want to maintain software com-

→

Address	Data	Instruction	Name	Function
FFCE	6C 1C 02	JMP (&021C)	OSFIND	*Open or close a file*
FFD1	6C 1A 02	JMP (&021A)	OSGBPB	*Load or save a block of memory to file*
FFD4	6C 18 02	JMP (&0218)	OSBPUT	*Save a single byte to file*
FFD7	6C 16 02	JMP (&0216)	OSBGET	*Load a single byte from file*
FFDA	6C 14 02	JMP (&0214)	OSARGS	*Load or save data about a file*
FFDD	6C 12 02	JMP (&0212)	OSFILE	*Load or save a complete file*
FFE0	6C 10 02	JMP (&0210)	OSRDCH	*Read a character*
FFE3	C9 0D	CMP #&0D	OSASCI	*Write a character + LF if a CR*
FFE5	D0 07	BNE &FFEE		
FFE7	A9 0A	LDA #&0A	OSNEWL	*Write a CRLF*
FFE9	20 EE FF	JSR &FFEE		
FFEC	A9 0D	LDA #&0D		
FFEE	6C 0E 02	JMP (&020E)	OSWRCH	*Write a character*
FFF1	6C 0C 02	JMP (&020C)	OSWORD	*Miscellaneous multi-byte OS operations*
FFF4	6C 0A 02	JMP (&020A)	OSBYTE	*Miscellaneous single byte OS operations*
FFF7	6C 08 02	JMP (&0208)	OSCLI	*Command line interpreter*

Figure 1 – Summary of the operating system routines showing the use of indirection vectors

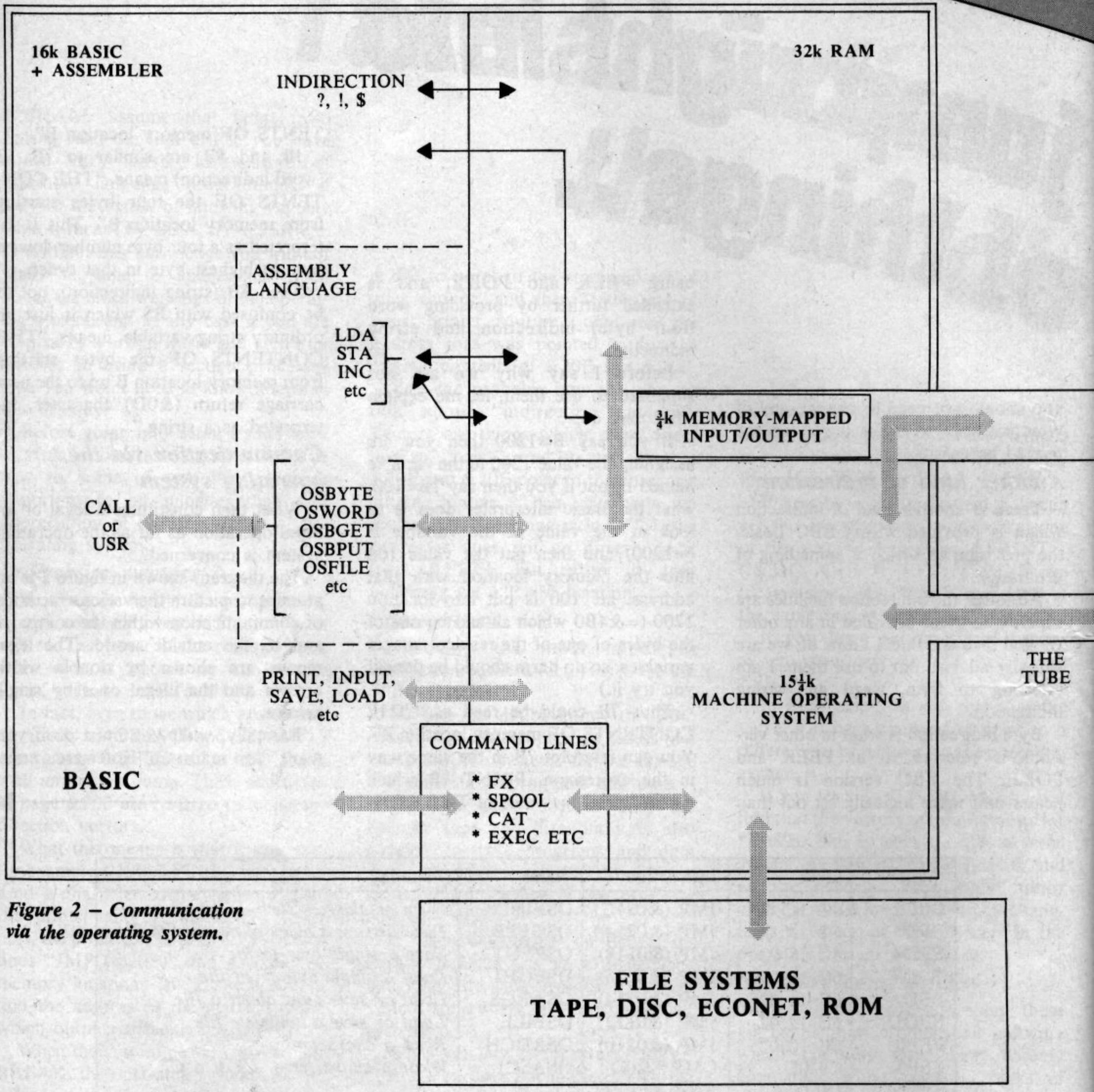

16k BASIC
+ ASSEMBLER
32k RAM
INDIRECTION
?, !, $
ASSEMBLY
LANGUAGE
LDA
STA
INC
etc
¾k MEMORY-MAPPED
INPUT/OUTPUT
CALL
or
USR
OSBYTE
OSWORD
OSBGET
OSBPUT
OSFILE
etc
THE
TUBE
PRINT, INPUT,
SAVE, LOAD
etc
15¾k
MACHINE OPERATING
SYSTEM
COMMAND LINES
* FX
* SPOOL
* CAT
* EXEC ETC
BASIC
FILE SYSTEMS
TAPE, DISC, ECONET, ROM

Figure 2 – Communication via the operating system.

patibility is, from within Basic, avoid using any of the indirection facilities and, in assembly language, avoid trying to access memory directly with LDA, STA, INC etc.

Both these restrictions apply whether you are addressing RAM or memory-mapped input/output.

This may seem a rather impossible restriction but there are routines within the operating system (among the OSBYTE and OSWORD routines) which provide facilities for accessing both input/output and also any RAM location within the computer.

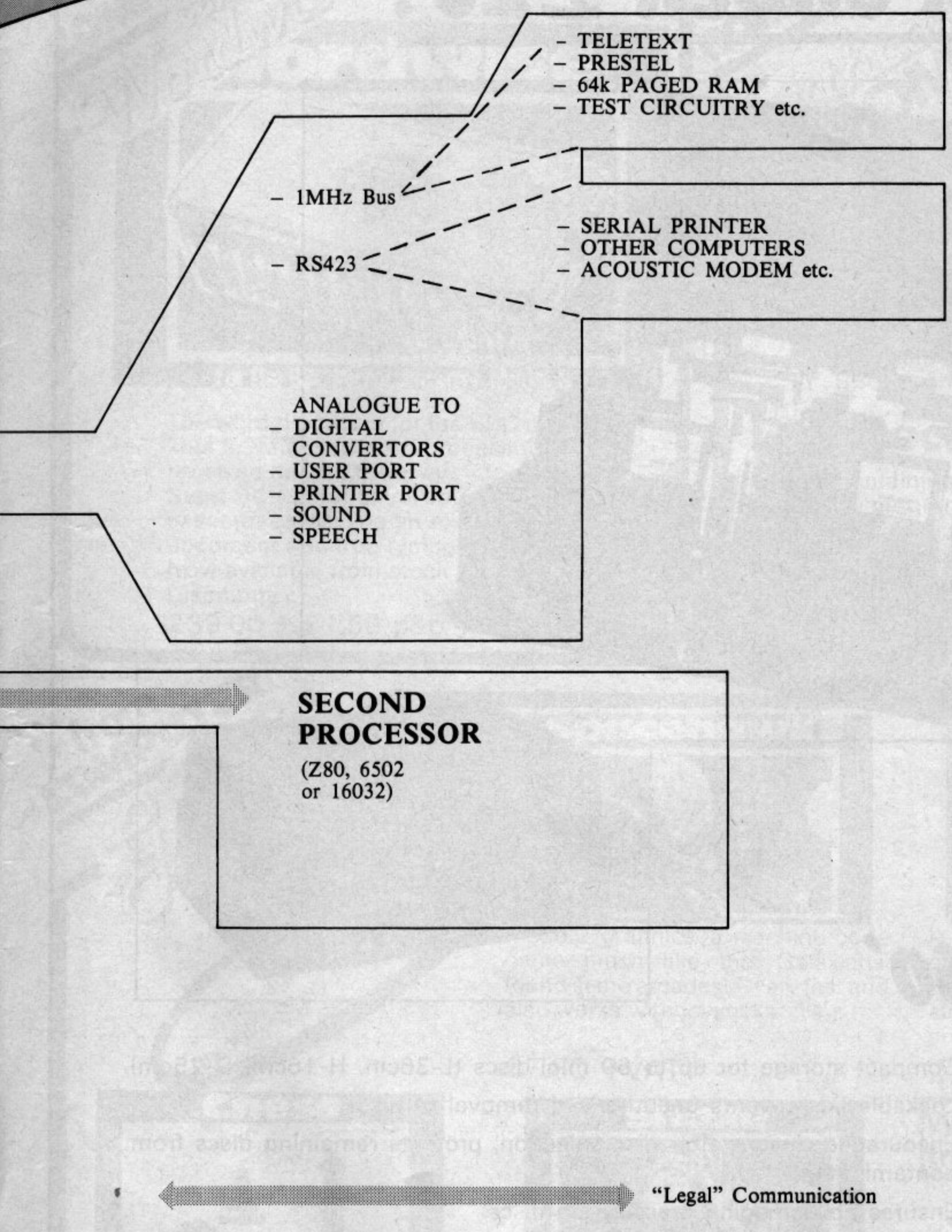
These routines are all "transparent to the tube". In other words, programs written using these routines will still work when run on the second processor, though if they are in machine code they will obviously only be applicable to the 6502 second processor.

To POKE or not to POKE?

Are there times when you have to go against the rules? Yes, I think there are.

First, if you are trying to do any work on interfacing using the user port on the 6522 versatile interface adaptor, then if you still have the 0.1 operating system, you have no option but to break the rules.

The OSBYTE routines for accessing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the memory-mapped input/output were not implemented before version 1.0.

However, even if you have got 1.0 or later, there may still be times when you have to break the rules. The main reason is that using these routines adds a few microseconds to the execution time.

In most applications this will be of no great importance but if, for example, you are doing some interfacing where speed is of the essence – such as high speed data acquisition or event timing – then the extra time needed to go via the operating system may be unacceptable.

Also, if one is realistic, it does require more effort to use the operating system routines than to access memory directly, and therefore the tendency is not to bother because of the short term savings in software development time.

I have to be careful what I say about this since I have certainly been guilty of breaking the rules myself, but I do think that in the longer term it is worth making the effort.

NEXT MONTH: How to use the OSBYTE and OSWORD routines, command lines and a look at the use of the *FX command.

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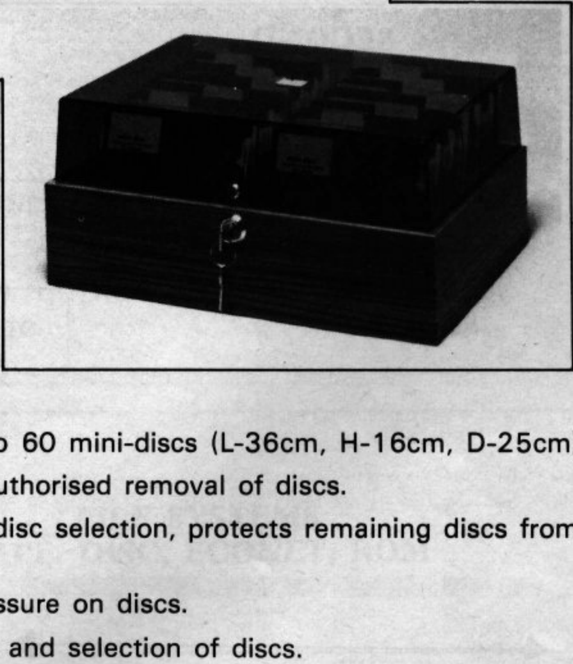

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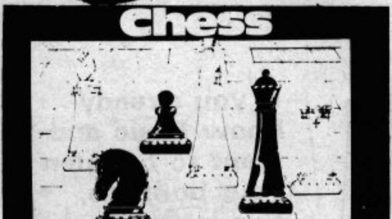

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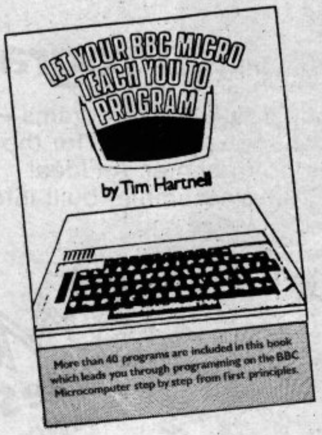
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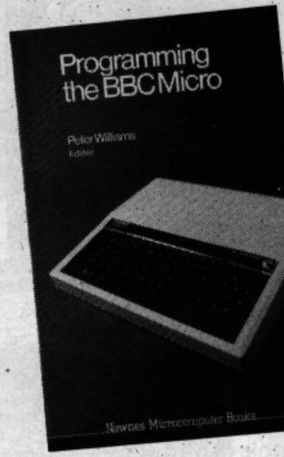
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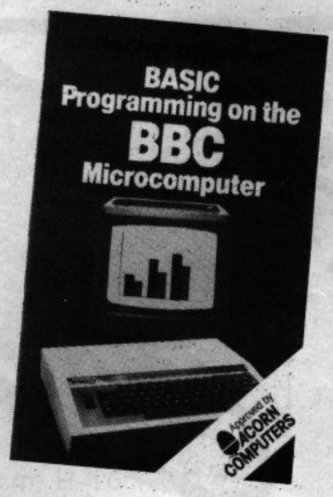
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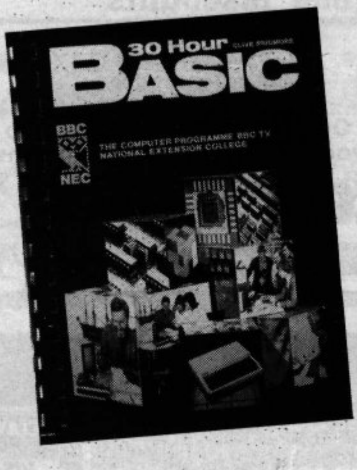
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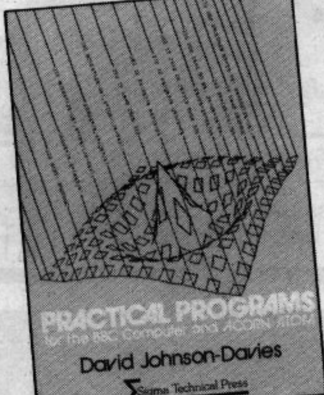
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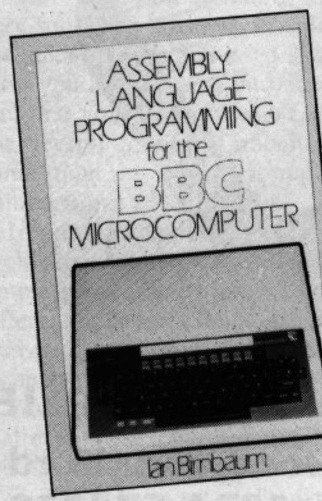
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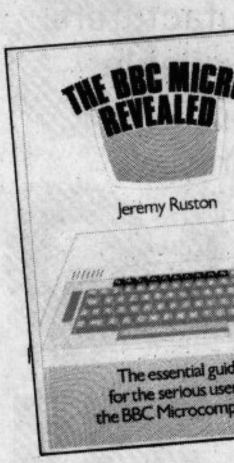
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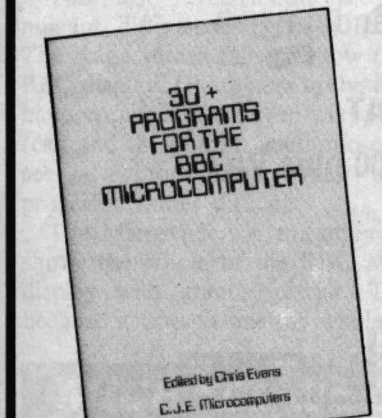
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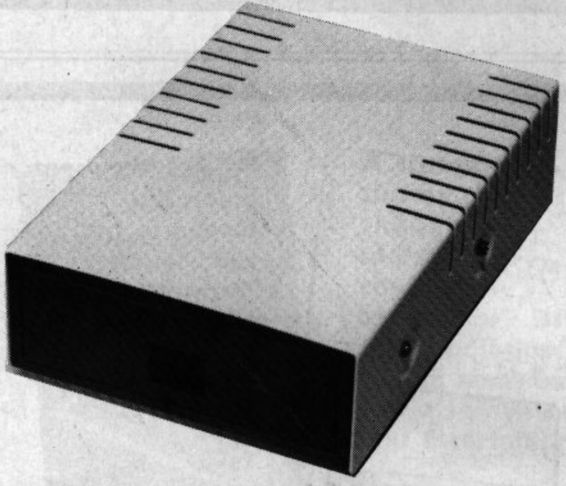

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HOW DO YOU VIEW?

MICHAEL NOELS LOOKS AT THE KAGA RGB VISION-1 AND THE MICROVITEC STANDARD MONITOR

THE two monitors we are reviewing this week are both at the lower resolution end of their makers' ranges. The first is from Kaga, their RGBvision-I, which retails at £285. The second, supplied by Silicon Express, is the Microvitec Standard monitor, selling at £249.

Now reviewing monitors can be a very subjective business, even following the guidelines we discussed last month. Also you have to take into account the fact that you probably won't be able to use several makes of monitor at the same time in order to make direct comparisons.

In an attempt to avoid these problems, I have devised four fairly simple programs which, when run on different machines, should enable objective comparisons of their behaviour to be made.

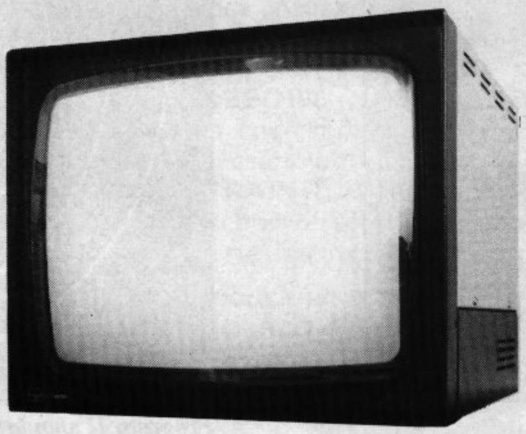
Perhaps the first point to make is that even these low resolution monitors are a great improvement on colour TVs. The colours are really nice! I preferred those of the Microvitec, which seemed to have a clarity the Kaga lacked.

Some colleagues, however, made the point that the Kaga's colours seemed richer and had more "depth". The Microvitec's white was certainly better than that of the Kaga, which was more a rather murky grey.

Program I was designed to test their ability to separate characters in an 80 column mode (Mode 0). It writes to each line – starting each with a string of Ws and Ms, the widest and hence least easily distinguished characters. Each line is numbered and concludes with a sample of normal text. The bottom line of the screen carries a message to the effect that you should be able to read it clearly.

This test revealed the most significant differences between the two. The Kaga screen fails to show the full BBC display. Characters in the top left hand corner of the screen were hard to read and the bottom line impossible to see – which often made editing programs rather difficult.

The Microvitec, on the other hand, shows the whole of the BBC Micro's display with greater clarity. This is because it doesn't use the whole of its screen for the display, as does the Kaga, but leaves a border round it – so avoiding missing characters and much of the inevitable distortion at screen edges.



The Microvitec also had the edge for general letter clarity. To be fair, while neither had the resolution to deal fully with the 80 column mode, most text was in fact quite legible.

Program II draws concentric circles, again in Mode 0. The Kaga, unfortunately, clipped the bottom off the outer circle. Its circles were, however, far rounder than the rather oval efforts of the Microvitec.

The point of Program III may not be immediately apparent. It tests, among other things, the power supply's ability to source the current needed for sudden screenfuls of colour. It does this by drawing a white box around the perimeter of the display, leaving the inside black. The inside then alternates black and white.

Now for reasons we won't go into

→

From Page 49

here this kind of sudden change is the very devil for the power supply to keep up with. If you look, you will see the actual borders of the screen collapsing inwards with each "flash". Actually, part of this is an optical effect, but if you lay a straight edge along the border you will clearly see it moving in and out.

Both monitors came out well from this test, with the Microvitec having the advantage. Laying the card along the edge also drew my attention to the amount of distortion due to screen curvature – far more on the Kaga than the Microvitec.

The final test takes rather more care to use than the others. Program IV draws a mesh of vertical and horizontal lines on the screen.

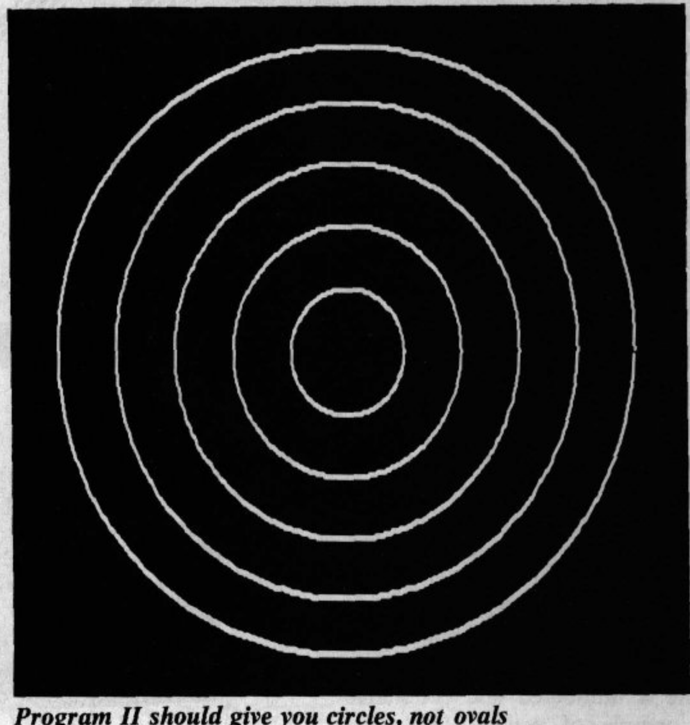
You can specify the number of graphical units between each horizontal, and each vertical, as well as choosing the mode. By using this in conjunction with the theoretical resolution possible in each mode (easily obtainable from Figure I of last month's graphic articles) you can test the monitors' comparative performance.

Thorough testing on both monitors showed that while both were capable of similar resolutions, the Microvitec's clarity at the extremes was noticeably greater.

Finally, though appearance is always a subjective factor, I must say that I prefer the appearance of the Kaga. Against that, though, is the Microvitec's hardier construction. On the Kaga the screen is covered with a rather flimsy plastic sheet, while the Microvitec's screen is covered with armoured glass. The latter point, combined with its BEAB approval, will tend to make the Microvitec the monitor of preference in the classroom.

```
   10 MODE 0
   20 CLS
   30 FOR I=1 TO 31
   40 PRINT "wwwwmwmwwwwwwmmmMMWWWWWWWW
WWWWW  NUMBER ";I;
   50 PRINT TAB(57)"This tests for
clarity"
   60 NEXT I
   70 PRINT "You should be able to
read this last line perfecly - up to
the final character";
   80 A$=GET$
```

Program I



Program II should give you circles, not ovals

```
   10 MODE 0
   20 FOR R=100 TO 500 STEP 100
   30 PROCcircle(R)
   40 NEXT
   50 END
   60 DEF PROCcircle(R)
   70 MOVE 640+R,512
   80 FOR I=0 TO 2*PI STEP 0.025
   90 DRAW 640+ R*COS(I),512 +R*SIN(I)
  100 NEXT
  110 ENDPROC
```

Program II

```
   10 MODE2
   20 VDU 19,2,7,0,0,0
   30 MOVE2,2:DRAW 1277,2:DRAW 1277,
1021 :DRAW 2,1021: DRAW 2,2
   35 GCOL0,2
   40 MOVE 8,4:MOVE 1271,4:PLOT 85,
1271,1019:MOVE8,1017 :PLOT 85,8,4
   50 REPEAT
   60 VDU 19,2,0,0,0,0
   70 FOR I=1 TO 1000:NEXT I
   80 VDU 19,2,7,0,0,0
   85 FOR I=1 TO1000:NEXT I
   90 UNTIL FALSE
```

Program III

```
   10 MODE 6
   20 INPUT '"Separation between
horizontals",horiz
   30 INPUT '"Separation between
verticals",vert
   35 INPUT '"Mode",x: MODE x
   40 FOR I%= 0 TO 1023 STEP horiz
   45 GCOL0,1
   50 MOVE 0,I%:DRAW 1279,I%
   60 NEXT I%
   70 FOR J%= 0 TO 1279 STEP vert
   75 GCOL0,3
   80 MOVE J%,0:DRAW J%,1023
   90 NEXT J%
```

Program IV

20	14	T	0	restore default logical colours
21	15	U	0	from keyboard delete current line in program – disable VDU drivers
22	16	V	1	select screen mode (MODE) – does not change HIMEM
			1	MODE number
23	17	W	9	user define screen character
			1	ascii character code
			2 to 9	–contents of each row making up character
24	18	X	8	define graphics window
			1 & 2	low and high byte of left x co-ordinate
			3 & 4	low and high byte of bottem y co-ordinate
			5 & 6	low and high byte of right x co-ordinate
			7 & 8	low and high byte of top y co-ordinate
25	19	Y	5	PLOT K, x, y
			1	plot action code
			2 & 3	low and high byte of x co-ordinate
			4 & 5	low and high byte of y co-ordinate
26	1A	Z	0	restore text and graphics default windows
27	1B	[	0	does nothing
28	1C	\	4	define text window
			1	left x position (units are character positions)
			2	bottem y position
			3	right x position
			4	top y position
29	1D	]	4	define graphics origin
			1 & 2	low and high bytes of x co-ordinate
			3 & 4	low and high bytes of y co-ordinate
30	1E	↑	0	home text cursor to top left of screen
31	1F	_	2	move text cursor to x,y position on screen
			1	x position (character position units)
			2	y position
127	7F		0	backspace and delete (equivalent to using delete key)

Plot Action Codes

0	move relative to last point
1	draw line in current graphics foreground colour
2	draw line relative in logical inverse colour
3	draw line relative in current graphics background colour
4	move to absolute position
5	draw line absolute in current graphics foreground colour
6	draw line absolute in logical inverse colour
7	draw line absolute in current graphics background colour
8–15	as 0–7 but last point omitted when inverting the colour
16–23	as 0–7 but with a dotted line
24–31	as 16–23 but without the last point plotted
32–63	reserved for extension
64–71	as 0–7 but only a single point plotted
72–79	reserved
80–87	as 0–7 but plot and fill triangle (using last two points visited)

Ian R. Hirst

Fold

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BBC Basic Keywords

ABS	absolute value	ERROR=ABS(X2-X1)	
ACS	arc - cosine	ANGLE=ACS(0.4)	ANGLE in radians
ADVAL	analogue to digital converter value	X=ADVAL(Z)	see note (1)
AND	logical AND or bitwise AND	IF X=9 AND Y=0 THEN... A=B AND C	logical bitwise
ASC	ASCII code for 1st char. of string	PRINT ASC("GOOD")	prints 71, ASCII code for "G"
ASN	arc-sine	ANGLE=ASN(0.5)	ANGLE in radians
ATN	arc-tangent	ANGLE=ATN(1.5)	ANGLE in radians
AUTO	auto line number	AUTO 100,5	start line number from 100, increment by 10
BGET#	get a byte from file	X=BGET#3	X becomes next value from file
BPUT#	put a byte to file	BPUT#3,5	sends value 5 to file 3
CALL	call machine code subroutine	CALL &FFF4 CALL 1234,A	call subroutine at FFF4(HEX) pass A in parameter block and call subroutine at 1234(DEC)
CHAIN	load and run program	CHAIN "PROG"	clears all except resident integer variables
CHR$	character string	PRINT CHR$(71)	prints character whose ASCII code is 71 ie "G"
CLEAR	clear variables	CLEAR	all except @% to Z%
CLOSE#	close file	CLOSE# CLOSE#0	close file 3 close all files
CLG	clear graphics screen	CLG	clear graphics area to current graphics background area
CLS	clear text screen	CLS	clear text area (incl.graphics) to current text background colour
COLOUR	select text colours	COLOUR 1 COLOUR (128+1)	set text foreground to red set text background colour to red
COS	cosine	PRINT COS(ANGLE)	ANGLE in radians
COUNT	count characters 'printed'	A=COUNT	counts all characters 'PRINT'ed
DATA	data to be READ	DATA 1,2,3,"A"	
DEF	define	DEF FNVAT (g)=0.15*g DEF PROCINIT	define functions and procedures
DEG	degree	Y=DEG(A)	converts angles in radians to degrees
DELETE	delete lines	DELETE 120,200	delete from line 120 to 200 inclusive
DIM	dimension array	DIM A(10) DIM X 10	create 11 element numeric array reserve 10 bytes pointed to by X
DIV	integer division	PRINT 11DIV2	produces 5 ie INT(11/2)
DRAW	draw	DRAW X,Y	draw from last point to X,Y in current graphics foreground colour
ELSE	else	IF X=0 THEN C=D ELSE...	alternative action for IF
END	end	END	optional program terminator
ENDPROC	end procedure	ENDPROC	
ENVELOPE	sound envelope	ENVELOPE (14 PARAMETERS)	see note(2)
EOF#	end of file	X=EOF#3	X is -1 if end of file 3 has been reached
EOR	exclusive OR	R=X EOR Y	bitwise logical operation
ERL	error line number	X=ERL	gives line number of last error
ERR	error	X=ERROR	gives error number of last error
EVAL	evaluate	X=EVAL(A$)	evaluate function in A$
EXP	exponent	Y=EXP(X)	Y becomes E raised to the power X

Fold

144	90	n	m	TV control, n sets vertical position, m=0 interlaced, m=1 non interlaced
145	91	0		Get character from keyboard buffer, Yreturns returns character C=1 if buffer empty, C=0 if character obtained
145	91	1		Get character from RS423 input buffer, Y returns character C=1 if buffer empty, C=0 if character obtained
146	92	X	Y	Read from FRED, X contains offset
147	93	X	Y	Write to FRED, X contains offset
148	94	X	Y	Read from JIM, X contains offset
149	95	X	Y	Write to JIM, X contains offset, character in Y
150	96	X	Y	Read from SHEILA, X contains offset
151	97	X	Y	Write to SHEILA, X contains offset, character in Y
224	E0	0	0	Cancel VDU queue
225	E1	0		Disable function keys (f0 to f9)
225	E1	1		Set function keys to generate strings
225	E1	n		Set base number of function keys to n
226	E2	n		Set base number of SHIFT function key codes
227	E3	n		Set base number of CTRL function key codes
228	E4	n		Set base number of SHIFT/CTRL function key codes
229	E5	0		Set escape key to interrupt a BASIC program
229	E5	1		Set escape key to return ASCII 1B(27)
230	E6	0		Enable flushing of buffers when escape key used
230	E6	1		Disable flushing of buffers when escape key used
231	E7	X		Set mask byte to X when servicing user 6522 IRQ
232	E8	X		Set mask byte to X when servicing 6850 ACIA IRQ

VDU Code Summary

Dec	Hex	CTRL	n	Meaning
0	0	@	0	does nothing
1	1	A	1	send next character to printer only
2	2	B	0	enable printer
3	3	C	0	disable printer
4	4	D	0	write text at text cursor
5	5	E	0	write text at graphics cursor
6	6	F	0	enable VDU drivers
7	7	G	0	make a short beep
8	8	H	0	backspace cursor one character
9	9	I	0	forwardspace cursor one character
10	A	J	0	move cursor down one line
11	B	K	0	move cursor up one line
12	C	L	0	clear text area (CLS)
13	D	M	0	move cursor to start of current line
14	E	N	0	page mode on
15	F	O	0	page mode off
16	10	P	0	clear graphics area (CLG)
17	11	Q	1	define text colour (COLOUR)
			1	colour number
18	12	R	2	define graphics colour
			1	action 0 plot specified colour
				1 OR specified colour with that already there
				2 AND specified colour with that already there
				3 EOR specified colour with that already there
				4 Invert the colour already there
			2	colour number
19	13	S	5	define logical colour
			1	logical colour number
			2	physical colour number
			3 to 5	zero

*	15	F	0		Flushes all internal buffers
*	15	F	1		Flushes the currently selected input buffer
*	16	10	0		Disables all ADC channels
*	16	10	1		Enables ADC channel 1 only
*	16	10	2		Enables ADC channels 1 and 2
*	16	10	3		Enables ADC channels 1,2 and 3
*	16	10	4		Enables all four ADC channels
	17	11	n		Forces start of convert on ADC channel n
	18	12			Resets user defined keys to no longer contain strings
	19	13			Forces machine to wait for next display frame
	20	14	0		Implodes soft character definition
	20	14	1		Explodes soft character definition
	21	15	0		Flushes the keyboard buffer
	21	15	1		Flushes the RS423 serial input buffer
	21	15	2		Flushes the RS423 serial output buffer
	21	15	3		Flushes the printer output buffer
	21	15	4		Flushes SOUND channel 0
	21	15	5		Flushes SOUND channel 1
	21	15	6		Flushes SOUND channel 2
	21	15	7		Flushes SOUND channel 3
	21	15	8		Flushes speech synthesis buffer
*	124	7C			Reset ESCAPE pressed flag
*	125	7D			Sets the ESCAPE pressed flag
*	126	7E			Acknowledge detection of ESCAPE condition

OSBYTE Calls

*	127	7F	n		Returns end of file status of file opened as n, X<>0 if EOF
*	128	80	0		Y returns last ADC channel to complete
*	128	80	n		For n=1 to 4, reads ADC channel n, MSB returned in Y, LSB in X
*	128	80	n	FF	For n=247 to 255, status of buffers returned in X
			247		speech buffer
			248		SOUND channel 3
			249		SOUND channel 2
			250		SOUND channel 1
			251		SOUND channel 0
			252		printer output buffer
			253		RS423 serial output buffer
			254		RS423 serial input buffer
			255		keyboard buffer
*	129	81	n	m	Read key with time limit, limit passed in X and Y(MSB)
					X returns key, Y=0 if key detected, 1B if ESCAPE, FF if no key
					If Y>&7F on entry then tests for specific key closure
*	130	82			Read machine higher order address
*	131	83			Read OSHWM, returned in X and Y(MSB)
*	132	84			Read bottom of display RAM address, returned in X and Y(MSB)
*	133	85	n		Read lowest address for mode n, returned in X and Y(MSB)
*	134	86			Return x and y co-ord. of cursor position in X and Y
	135	87			Read character at text cursor position, X returns char.
					Y returns current display mode
	136	88			Reserved
**	137	89	0		Turn cassette motor off
**	137	89	1		Turn cassette motor on
	138	8A	0	n	Insert character ASCII n into keyboard buffer
	139	8B	n	m	Controls file options, see page 398
*	140	8C	0		Sets default tape speed
*	140	8C	1		Sets tape speed to 300 baud
*	140	8D	2		Sets tape speed to 1200 baud
	141				Reserved
	142				Reserved
	143				Reserved

Fold

EXT#	extent	N=EXT#(3)	determines size of file 3 in bytes (not cassette)
FALSE	false	X=FALSE	numerical value (0) representing false
FN	function	A=FNMEAN(X,Y)	indicates user defined function
FOR	for....next	FOR X=1 TO 5	loop executed at least once
GCOL	graphics colour	GCOL 0,2	see note (3)
GET	get key code	X=GET	no echo to screen, X contains key code
GET$	get string	X$=GET$	no echo to screen, X$ contains key character
GOSUB	go to subroutine	GOSUB 4000	
GOTO	goto line	GOTO 330	
HIMEM	highest memory	HIMEM=HIMEM-40	variable pointing to highest memory used
IF	if	IF X=2 THEN 200	THEN, and ELSE optional
INKEY	input key number	Y=INKEY(5)	Y returns value of any key pressed within 50ms
		Y=INKEY(-66)	tests for A being pressed, -1 : no key
INKEY$	input key string	Y$=INKEY$(20)	waits 200ms, returns $
INPUT	input to computer	INPUT X	accepts numeric, prints ?
		INPUT "TYPE NAME" N$	suppresses ? (no comma)
		INPUT "WHAT AGE",A	prints ?
		INPUT LINE A$	accepts anything in a line
INPUT	input from file	INPUT#3, A,B	inputs from file 3
INSTR	in string	INSTR("HELLO", "L")	returns position of 2nd string in 1st(ie 3)
INT	integer part	X=INT(5.3)	next smallest integer (ie 5)
		X=INT(-5.3)	gives -6
LEFT$	left string	PRINT LEFT$(A$,N)	prints left N characters of A$
LEN	length of string	X=LEN(A$)	returns length of A$
LET	let	LET A=2	LET is optional
LIST	list prog.	LIST 200	print line 200
		LIST 100,300	list from line 100 to 300
		LIST, 300	list upto 300
LISTO	list option	LISTO 0	insert no spaces during LIST
		LISTO 7	format with spaces
LN	natural log	X=LN(A)	
LOAD	load program	LOAD "MYPROG"	clears all variables except @% to Z%
LOCAL		LOCAL A,B,Z$	declares variables local in PROC or FUNCT.
LOG	logarithm	Y=LOG(X)	log to base 10 of x
LOMEM	low memory	PRINT LOMEM	pointer to start of variable memory
MID$	middle string	A$=MID$(Y$,I,J)	A$ returns J characters starting from Ithin Y$
MOD	modulus	X=12 MOD 5	returns remainder after division (ie 2)
MODE	graphics mode	MODE 5	select graphics mode see note (4)
MOVE	move	MOVE X,Y	move graphics cursor to absolute position
NEW	new program	NEW	removes a program
NEXT	FOR...NEXT	NEXT	indicates end of FOR...NEXT loop
		NEXT I	'pops' FOR-NEXT until I is found
NOT	logical NOT	IF NOT (A=6) THEN	logical not
		A= NOT 8	equivalent to unary minus (A=-B)
OLD	old program	OLD	restore program deleted by NEW
ON	on	ON X GOTO 1000,2000	if X=1 goes to 1000, if 2, then 2000
		ON X GOSUB 100,200,300	
		ON ERROR GOTO 1500	errors handled by 1500
		ON ERROR OFF	restores normal error handling
OPENIN	open file for input	X=OPENIN("filename")	opens file called "filename" and allocates channel number
OPENOUT	open file for output	X=OPENOUT("filename")	if file does not exist, it is created
OPT	assembler option	OPT N	N=0 errors suppressed, no listing
			N=1 errors suppressed, listing
			N=2 errors reported, no listing
			N=3 errors reported, listing
OR	logical OR	IF A=6 OR B=2 THEN...	
PAGE	page	PAGE=&5000	variable which points to program start
PI	pi	AREA=2*PI*R	constant=3.14159265
PLOT	plot	PLOT 4,50,50	multi purpose see note(6)

POINT	point	colour=POINT(X,Y)	returns colour of point X,Y(-1 off screen)
POS	position	X=POS	returns position of text cursor
PRINT	print	PRINT A,B	for format see note (7)
PRINT#	print to file	PRINT#3,A	prints A to file 3
PROC	procedure	PROCINIT	indicates user defined procedure
PTR#	pointer	PTR#4=100	sets pointer to non-cassette file
RAD	radian	X=RAD(Y)	converts from degrees to radians
READ	read	READ A$,2	read from DATA statement
REM	remark	REM comment	indicates rest of line is comment
RENUMBER		RENUMBER	renumbers from 10 with increments of 10
		RENUMBER 100,20	renumbers from 100 with increments of 20
		RENUMBER 50	renumbers 50 with increments of 10
REPEAT	repeat...until	REPEAT	repeat loop always performed at least once
REPORT	report error	REPORT	reports last error in words
RESTORE	restore data pointer	RESTORE	sets data-pointer to first DATA line
		RESTORE 2000	sets data-pointer to DATA line 2000
RETURN	return from subroutine	RETURN	indicates end of subroutine
RIGHT$	right string	A$=RIGHT$(X$,3)	selects last 3 char of X$
RND	random	X=RND(N)	N<0 resets generator
			N>0 generates random no >0 and <N
			N=0 reports last number with N=1
		X=RND	generates integer between
			-2147483648 and 2147483647
RUN	run program	RUN	clears all variables except @% to Z%
SAVE	save program	SAVE "FRED"	save on cassette or disc
SGN	sign	X=SGN(Y)	returns sign of Y (ie +1,0, or -1)
SIN	sine	X=SIN(ANGLE)	ANGLE in radians
SOUND	sound	SOUND 1,-15,53,20	see note (8)
SPC	space	PRINT SPC(6);A	generates 6 spaces followed by A
SQR	square root	X=SQR(Y)	negative roots cause error
STEP	step	FOR X=1 TO 7 STEP 2	optional,defaults to 1
STOP	stop	STOP	may be restarted with GOTO...
STR$	string	A$=STR$(X)	converts number to string representation
STRING$	repeat string	A$=STRING$(4,B$)	A$ becomes 4 times B$
TAB	tabulate	PRINT TAB(10);"HELLO"	Tabs to 10th column of correct line
		PRINT TAB(2,10);"HELLO"	moves text cursor to 2,10 & prints HELLO
TAN	tangent	X=TAN(ANGLE)	ANGLE in radians
THEN	IF...THEN...ELSE	IF A=2 THEN 350	OPTIONAL
TIME	time	TIME=((H.*60+MIN)*60+SE)*100	time in 10ms intervals
			may be read or set
TO	FOR...TO...NEXT	FOR X= 1 TO 5	
TOP	top pf program	PRINT TOP	pointer to end of user program
TRACE		TRACE ON	print line numbers during prog execution
		TRACE OFF	turn off trace
		TRACE 6780	report line numbers below 6780
TRUE	logical true	IF RESULT=TRUE	logical true =-1
UNTIL		UNTIL X>10	terminates REPEAT LOOP
USR	user	X=USR(&3000)	calls subroutine and returns value from
			P,Y,X,A registers
VAL	value	A=VAL(B$)	converts number represented by B$ to number
VDU	vdu driver	VDU 28,0,5,39,0	multipurpose statement see note(9)
VPOS	vertical position	V=VPOS	returns vertical position of text cursor
WIDTH	page width	WIDTH 60	sets page width used by computer (0 initially)

Fold

FX and OSBYTE Call Summary

	dec	hex	X	Y	Function
*	0	0			Prints operating system version number
	1	1			Reserved for applications programs
	2	2	0		get characters from keyboard and enable RS$ receiver
	2	2	1		get characters from RS423 port
	3	3			Select output devices
	3	3	0		Selects printer and screen
	3	3	1		Selects printer, screen and RS423
	3	3	2		Selects printer
	3	3	3		Selects printer and RS423
	3	3	4		Selects screen
	3	3	5		Selects screen and RS423
	3	3	6		Selects no output
	3	3	7		Selects RS423
*	4	4	0		Cursor editing keys and copy key perform normally
*	4	4	1		Cursor editing keys and copy key return ASCII codes
*	5	5	0		Selects printer sink
*	5	5	1		Selects parallel printer connection
*	5	5	2		Selects serial RS423 printer connection
*	5	5	3		Selects user supplied printer driver
*	6	6			Selects the printer ignore character, e.g.
*	6	6	8		Printer ignores ASCII 8 character
*	7	7	1		RS423 input set to 75 baud
*	7	7	2		RS423 input set to 150 baud
*	7	7	3		RS423 input set to 300 baud
*	7	7	4		RS423 input set to 1200 baud
*	7	7	5		RS423 input set to 2400 baud
*	7	7	6		RS423 input set to 4800 baud
*	7	7	7		RS423 input set to 9600 baud
*	7	7	8		RS423 input set to 19200 baud (This rate not guaranteed)
*	8	8	1		RS423 output set to 75 baud
*	8	8	2		RS423 output set to 150 baud
*	8	8	3		RS423 output set to 300 baud
*	8	8	4		RS423 output set to 1200 baud
*	8	8	5		RS423 output set to 2400 baud
*	8	8	6		RS423 output set to 4800 baud
*	8	8	7		RS423 output set to 9600 baud
*	8	8	8		RS423 output set to 19200 baud (This rate not guaranteed)
*	9	9	n		Flash rate, duration of first colour set to n/50 of a second
*	10	A	n		Flash rate, duration of first colour set to n/50 of a second
*	11	B	n		Repeat key delay set to n/100 of a second
*	11	B	0		Turn off repeat key
*	12	C	0		Reset repeat delay and repeat rate to default values
*	12	C	n		Set repeat rate to n/100 of a second
	13	D	0		Disable output buffer empty event
	13	D	1		Disable input buffer full event
	13	D	2		Disable character entering input buffer event
	13	D	3		Disable ADC conversion complete event
	13	D	4		Disable start of vertical sync. event
	13	D	5		Disable intervval timer crossing zero evvent
	13	D	6		Disable ESCAPE pressed event
	14	E	0		Enable output buffer empty event
	14	E	1		Enable input buffer full event
	14	E	2		Enable Character entering input buffer event
	14	E	3		Enable ADC conversion complete event
	14	E	4		Enable start of vertical sync. event
	14	E	5		Enable interval timer crossing zero event
	14	E	6		Enable ESCAPE pressed event

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MARCH ISSUE: **DEATHWATCH,** a superb arcade game that challenges you to use your skill to fight off enemy battleships, tanks and helicopters; **BINGO,** illustrating clever uses of the randomise function; **BUBBLESORT** routines; **TESTS** for function keys in machine code routines; a useful **CASSETTE BUGS FIX** for users with OS 0.1 . . and many **COLOUR AND GRAPHICS ROUTINES** to help you create a kaleidoscope of screen designs which you can incorporate into your own programs.

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I'M FREDDIE – FLY ME!

More unique BBC programs exclusively from Kansas

F FOR FREDDIE IS THE HARDEST GAME THAT YOU WILL EVERPLAY!

Requires absolute concentration to prepare, take-off, fly and land a tri-star jet at varying destinations using a staggering 36 control keys!

If you only play the arcade type of game, needing just a couple of keys and the space bar to play, then this is most certainly not for you

If however, you are prepared to sit at your computer for literally hours on end getting to grips, and then give a considerable amount of effort and time into actually trying to solve it, then this is definitely for you.

Though F for Freddie is a flight simulator type of game, it is not one with simple operation and the ground appearing at the front of you, but is as accurate a simulation of not only flight, but preparation, take-off and the many more occurances associated with flying a tri-star jet as a 32K micro will allow.

Controls? A mind boggling 36 of them! And it is here where the logic and skill comes in, as everything must be done not only in the correct order but at the right time. Yes, it's in real time, with the clock ticking relentlessly away.

But the great asset of this 'game' is that every little piece of information you require is shown on the screen, nearly fifty in all, continuously being updated, with the colours being cleverly used to depict different, changing, situations.

Eventually you will master the take-off, then even manage to fly and at long last manage to land. But unlike all other games, at this stage you don't put it away for ever, for you have seven different destinations, all on different courses and distances...

There are plenty of instructions on the 36 controls and even a little advice, but as the whole thing is a colossal challenge, you are not told how to fly Freddie, this you have to discover entirely for yourself...

At times you will wish, as most certainly will your family, that you never bought the blasted thing!

£9.50 Vat and post paid

For the children alone...

Magic Adventure

In Magic Adventure, Beth and David Guest have created a wonderland journey for children between 4 and 10.

Simple in operation, using the User Defined Keys, it nevertheless uses the BBC to its full with colourful pictures and wonderful story.

As the child brings up the locations, a simple question is asked, with the adventure proceeding in different way depending on the response.

The scenes include the Talking Tree—who played a nasty trick on a friend so was punished by the Fairy. But if the Talking Tree helps later on, all with be forgiven...Poor mother rabbit needs help to count her babies...Dare the Cage be opened...what is in the Grassy Field... can the King's Spell Jar be found...what is the real colour of the Glasses...will the fairies dance......is the Castle locked...where does the Path lead...will the Fairy come...will there be a surprise...

With everything illustrated in colourful graphics, this is a delightful example of the programmers' art and refreshingly different from anything ever done before. Sound of course.

As scene upon scene enfolds, the children will be more and more entranced as they go on their Magic Adventure...

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Doubtless Bach would have some byteing comment

Music (BBC Software)

MUSIC is a useful tool for those who want to explore the BBC Micro's facilities for music making without getting involved in complicated programming.

The program allows you to record three separate lines of music, and then to alter various aspects of the sounds which they produce. You enter the music using the BBC keyboard, and the notes are displayed on the screen.

You may play back any or all of the three lines at the same time, and also alter the speed. There is a choice of four different "voices" in which the sounds can be played, and if you want to keep a tune permanently you can easily save it on a spare tape.

All the lines are displayed on the screen and are horizontally scrolled along as the music is played. Also there are full editing facilities for altering the score once you have entered it.

The musical effects produced are quite good. The accompanying booklet says that the "instruments" quality should not be taken too seriously, and this is true. The alteration in tempo is a useful option, and loading and saving is easy.

However, the graphics used don't really look like notes, although they are sufficient to give a rough idea of the tunes. The basic note is represented by a square block, and longer ones are simply oblongs. The length of each note is picked up directly from the keyboard, so you have to concentrate very hard to get the effects you want.

It is very difficult to get the three lines in sync because of this, but it can be done and the three part harmonies are very good when played back. Unfortunately you cannot mix instruments so that all lines must be played back in the same voice.

The editing of tunes is done quite easily, though sometimes it is difficult to change the length of a note.

Despite some problems in entering and amending music, the program is fun to use and can produce some pleasant results. It doesn't attempt to fully exploit the BBC Micro sound facilities, nor do the graphics give an ideal representation of the music.

However it is entertaining and probably useful to those who already have some musical knowledge, and wish to combine this with computer play.

Jane Jackson

Grafkey.. clever but covert

Grafkey (Clares)

I'VE had difficulty writing this review because on the one hand it's going to enthuse over an excellent product and on the other . . . well, I'll come to that.

As the blurb would have it Grafkey is a program which allows various shapes and lines to be drawn anywhere on the screen using the keyboard.

They can be drawn using 2, 4 or 16 colours and the picture may then be saved to tape and used in other programs. And that is exactly what it does, only more so.

Grafkey is a superb diagram creating program. Once you've got the hang of it, it's easy to use and I have found creating pictures using it is as much fun as playing any of the video games reviewed recently.

The more you use it the more it has to offer and the greater number of applications occur to you. It's all written in Basic and is very clever, very useful stuff.

Teachers will find the ability to call a sequence of colourful diagrams from tape invaluable.

If you're after graphics software think seriously about Grafkey or its sister program Grafstick, which is exactly the same but uses a joystick.

The fly in the ointment is that you have to be prepared to spend time learning how to use it, as the instructions supplied are woefully inadequate, especially when you consider that most of the users will not be experts on the BBC Micro.

This, I'm told, is as a result of additions to the original package outstripping the written instructions. However, revised, simpler and more comprehensive instructions are on the way.

Having said all that, anyone with any enthusiasm and a little time can soon sort it out. It's fun doing it and well worth the trouble.

An excellent product that does what it says it will do and more besides. Thoroughly recommended.

Nigel Peters

MORE SOFTWARE REVIEWS ON PAGES 58 & 59

You can cheat at Chess if all else fails..

Chess (Bug-Byte)

THIS attractively packaged program loads at 1200 baud, but although there is no 300 baud back-up I had no problems loading it, taking just under two minutes.

It runs automatically once loaded (the command *RUN "CHESS" must be used). The usual choice of black and white is given and the required skill level should be selected according to the player's ability.

The program suffers from the usual problem that the waiting time is inversely proportional to the skill level.

The visual display has clarity and is asthetically sound, the pieces being easily distinguishable with the possible exception of the queen and rooks. For no apparent reason the number 44 appears in the top right corner of the screen. It is constantly displayed throughout the game and has been the subject of much speculation as to its purpose.

Movement is achieved by means of a simple grid system and any illegal responses are rejected. The program provides for castling, but curiously not for en passant so far as the player is concerned. I eventually had to admit defeat after prolonged provocation on this point.

The menu can be accessed by pressing RETURN, when the prompt appears. The menu then gives a wide selection of available actions including listing moves made during the current game, saving unfinished game on tape and rearranging the current board (useful for cheating when all else fails!). Avoid the ESCAPE key when in this mode or the program will crash.

Overall, Bug-Byte Chess is excellent practice for all budding grand masters and will accompany a player up to a high level of skill. I would recommend it as a good candidate for any program collection despite the unusually high cost.

Chris Turnbull

Just one more, then you can have a go

Connect 4 (Database)

MY wife's happy – at last she's beaten the computer! Mind you, it took her several dozen attempts, but she is delighted. You see, I haven't and it's not for the want of trying – it's because of the sneaky programming by those devils at Database.

I must admit that when I got Connect 4 for review I thought: "Why bother, why not buy the game proper from the toy shop?" But that was before I discovered the solitaire version where you play with the computer – or rather it plays with you. It's addictive, infuriating and attracts too many people who look over your shoulder and give advice, good and otherwise.

For those of you who don't know Connect 4, it's an abstract logic game where you have to fill a 6 by 7 array with circles, taking alternate turns with your opponent.

The idea is to get four circles in a row – either horizontal, vertical or diagonal – to win. Only you don't if you're playing the solitaire version – unless you're my wife and I was standing behind her giving her advice!

For such an easily learnt game it gets surprisingly complicated, but remains fun. Your hand goes instinctively for the replay and you find yourself saying "just one more, then you can have a go" . . . the chant that marks the end of every good video game.

Pete Bibby

Tess (H & H)

TESS, a pattern-drawing programme, takes a bit of learning but is worth it. The idea is that you are presented with a white square on a black background and on this you create the picture of your choice using the user defined function keys.

Once you have drawn this basic pattern you can then "tessellate" or produce regular patterns of various sizes and colours. The range of possibilities is enormous and the basic patterns can be saved, loaded and used again to create yet more tessellations.

The only criticism is that the instructions are not complete enough or, rather, they are all there but are not available during use.

A few "cribs" during the actual drawing stage would save a lot of mistakes when Tess is first used.

Having said that, after a time the instructions become second nature and the pleasure of creating the tessellations takes over.

Katherine James

GAMES and GUIDANCE from BBC Software

Fun Games

A COLLECTION of four traditional games nicely presented and colourful:

Breakout: A BBC adaptation of one of the earliest arcade games. Eight lines of bricks have to be knocked away, using three balls and either a large or small bat, which is controlled with the keyboard.

The large bat takes a while to get used to and the smaller one is almost impossible except after many hours of practice. To make things more fun, once you're through the fourth line of bricks the ball speeds up.

If you do manage to clear all the bricks, a new screenful is presented for you. Altogether it is a good addictive version, which can be incredibly frustrating.

Dodgems: You drive a car around an oblong maze of roads, running over dots while attempting to evade the persistent attacks of the computer car. With a little practice it gets easier to predict the movements of the computer car, and so by changing lanes at each junction (by using the keyboard) you can usually get most of the dots before things get too tricky.

The added option of speeding up your car allows you to eat more dots but also makes it more difficult to change lane – and thus avoid the pursuing computer car.

The graphics and sound are good – particularly the vivid blue/yellow crashes.

Flash: A deceptively simple memory game – do you remember "Simon"? Four blocks of colour, each with an accompanying sound, are flashed onto the screen. You have to remember and enter into the computer the colours/sounds, in exactly the order in which they were shown.

Although you can choose the speed that the colours/sounds appear, even the slowest is difficult to remember when the sequence reaches more than twenty.

Flash is an attractive game, in which the computer takes an almost human delight in instantly telling you of any mistakes the second in which they occur.

Snake: This is perhaps the best of all of the four. You become a letter-hungry snake, slithering around the screen in search of letters to eat. The further down the alphabet the letter is when you eat it, the more points you get.

Unfortunately, as you manoeuvre the snake around the screen it grows longer and longer, and so it becomes more difficult to avoid crashing into your own tail.

Also, of course, you musn't hit the surrounding walls, or just when you think you are getting the hang of things a letter appears in an unexpected place, and the snake inelegantly bites the dust.

Programs I

THIS collection of 12 programs was originally written for "The Computer Programme", and demonstrates many of the useful facilities of the BBC Micro.

The programs are very useful for those who have a grasp of programming and want some ideas on how to use their knowledge effectively. All can be listed and are clearly written with plenty of REM statements, which means one can modify programs and easily monitor the effects.

Owl is a simple graphics offering which draws the BBC Owl and makes him blink. It employs useful graphics techniques, and is a good starting point for exploring further ideas.

Ball a simulation of a bouncing ball, closely models the true flight path by displaying the ball and its path on the screen. A good program for basic animation and for representing real events in an accurate way.

Sales is a very simple way to draw graphs.

Bubble shows how a bubble sort works. It is useful in applications of programs to basic data manipulation.

Cube produces a rotating 3D cube by using basic animation effects, with some efficient programming to allow relatively fast movement.

Languages provides a colourful arrangement of the names of computer languages. The characters are created using the VDU23 command to define each original character into two halves, which are then displayed.

Flowers is the graph of an elliptical function, but it draws some very attractive pictures anyway. Also sounds are used.

Anagrams takes a word entered and rearranges the letters in every possible sequence, most of which are nonsense.

Weaving is a strange program, apparently designed to illustrate ideas about binary. Anyway, it draws pictures of the different ways of weaving threads through up to eight warps.

Sideways turns the BBC screen on its side. Very baffling, and another useful illustration of altering the standard character set and rearranging it.

Coins is a graphic version of an old problem – to find the one counterfeit coin out of 10 by the smallest number of weighings. Procedures are used for the various aspects of the program.

Plotter produces very effective 3D graphs. The results are attractive even if you don't understand the maths behind them.

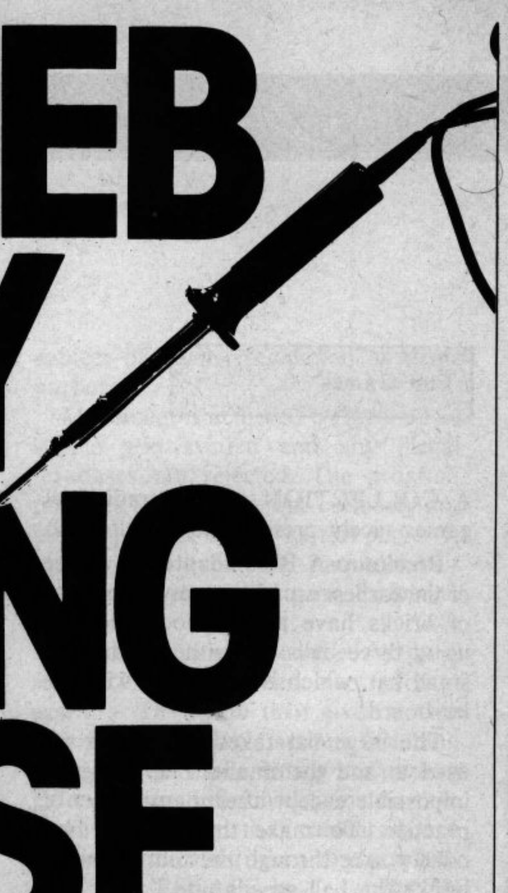
Altogether this is an interesting collection of programs which would be useful to anyone interested in getting the most out of their BBC Micro but who perhaps needs some help in doing it.

The graphics are particularly appealing, and are bound to encourage those who want to develop this particular aspect either for entertainment or for making learning more fun.

Jane Jackson

PART 2

THE BEEB BODY BUILDING COURSE



LAST month we looked at the parts of a model A to model B upgrade that did not require any soldering. So now get out the soldering iron and let's have a bash at making your model A a fully fledged B.

However, as we saw last month, it is not necessary to do all the parts of the upgrade, so you can save yourself a bit of money.

To start off I would like to say a little bit about soldering and soldering irons. Those already perfectly confident about soldering can skip the next section.

Well, now that we have the know-alls, out of the way, we can begin. Soldering is really quite simple if you have the right tools and follow a few simple rules.

However the results that can be achieved by a real idiot wielding a poker on a computer printed circuit board can be quite horrendous, and many attempts I have seen have probed the bounds of my sanity.

The first and most important piece of equipment is the soldering iron. You usually only buy one, so make it a good one.

Soldering irons are described by their wattage – that is how much heat they will produce. Also the size of the tip is an important indication as the fineness of the work that can be undertaken.

Look on the back of your computer printed circuit board. you could not solder joints that close together without about a $\frac{1}{8}$th inch tip or smaller.

Irons come in two types – those whose temperature is regulated, and those not so. In my opinion there is no place in computer electronics for the unregulated soldering iron.

Computer work requires a small tip size and if it is a low power soldering iron (10-20 watts) the tip will lose all its heat after making only one or two joints, and you will have to wait about three minutes before you can make the next one.

What tends to happen is that you don't wait, thinking that if it can melt the solder then it must be all right. And you will find you are wrong!

You will get what is known as a cold or dry joint, which looks all right but doesn't actually make any electrical connection. In an effort to avoid this, people buy an iron with a large rating of 25 to 50 watts and a small tip. As a result the tiny tip overheats, causing it to quickly burn away. In the meantime it produces bad joints because the tip is too hot as well as making the soldering iron handle too hot to hold comfortably.

The answer is to have a regulated iron, one that controls the amount of heat going to the tip. There are two types, the ones with a thermostat in the handle being the least expensive. However these provide little more than a variable on-off duty cycle dependent upon the thermostat screw setting.

They can prevent a small tip from burning out and are definitely better than an unregulated iron. However there is no feedback from the tip to the heater that it is being used, and so the same amount of heat is always transferred to the tip. This causes the tip temperature to drop when joints are made in quick succession.

The way round this is to use some form of feedback regulation. Unfortunately this type is the most expensive, but when you consider the price you have paid for your computer the cost of a top quality soldering iron is relatively small. Prices vary but expect to pay around £30 for a quality job.

The temperature feedback works on an interesting principle. The soldering iron tip has a magnet built into it, which causes a sensitive switch inside the heating element to close and turn on the heater. When the magnet has reached a certain temperature (called its Curie point) it suddenly loses all its magnetism, causing the switch in the heater to turn off.

As the tip cools it drops below the Curie point, regains its magnetism, and turns on the heater. In this way a relatively stable temperature is maintained. For example, when the tip is applied to a joint, the heat is sucked out of the tip and the heater immediately turns on. Using this principle it is possible to have a 40 watt iron with a one-sixteenth inch tip or smaller with the back up power to tackle any joint.

There are several irons on the market advertised as low leakage, implying that they are essential for soldering MOS devices. They are not, and most of the time you will be soldering empty sockets or devices in circuit, so you do not really have to think about using them.

Remember that it takes a great deal of skill to produce a good joint from a bad iron so why make things deliberately difficult for yourself?

My particular favourite soldering iron is a Weller Soldering pencil TCP, which is a low voltage iron driven from a transformer built into the stand. This is not the only one that fits all the requirements, but is well worth the money.

Having got a good soldering iron it is comparatively easy to use. To make a good joint use resin cored solder, and I would recommend 22 SWG thickness.

The iron, solder and the joint must all come into contact at the same time. Consider the process carefully. Slowly feed the solder in and when you see the solder run around the joint remove the iron and solder.

Do not move the joint while the solder is molten or you will get a dry joint. You can usually tell when a joint sets by noting a slight change in how the surface reflects the light. That is really all there is to it.

However, simple as it may seem, some people somehow manage to get it wrong, so here is a list off do's and dont's:

DON'T use the soldering iron tip to carry solder to the joint.

DON'T try to melt the solder on the joint by applying the iron to one side of the joint and the solder to the other – apply all three at the same spot.

DON'T pile on too much solder so that it splashes or makes a bridge to the next connection.

DO leave the soldering iron on the joint long enough to make a proper joint. Most beginners are frightened about getting components too hot and as a result don't get the joint hot enough, which leads to dry joints and solder tails when the iron is removed.

Solder tails can short things out, especially when the printed circuit board is screwed back down to the base of the case. Most components and printed circuit boards are rated to withstand soldering temperatures for at least ten seconds.

This might not sound very long, but you time it and you will find it more than adequate to make several joints, let alone one.

DO make sure the tip is in contact with the pin and the printed circuit board track. I have seen many so-called joints that are just solder stuck to the top of the pin with no connection to the track on the board.

DO keep the tip of the soldering iron clean. This can be done by giving it a quick wipe on a damp sponge (a real one, not the foam type) after every 10 or so joints. Do not file the tip, because the good ones have an iron coating to protect the copper from eroding.

DO tin the iron before using it. This involves melting a small amount of solder on the tip. This is known as wetting the tip and allows good thermal contact between the tip and joint. You will need to do this every time you wipe the tip. If you don't the joint will not heat up as the area of contact between tip and joint will be very small.

If all that is a little daunting, on the work we are going to tackle this time there is only one place where bad soldering can cause the computer to fail and I will warn you of that so you can miss it out until you have more confidence.

THE BEEB BODY BUILDING COURSE

This month the only things that needs soldering are the connectors and it is one of the stranger facts of life that of all the extra components the plugs and sockets cost more than the integrated circuits!

So if you omit the connector and solder wires into the board and connect the other end to a cheap screw connector block available at most DIY shops you can save a mint.

The disadvantage is that you will have wires trailing out of your machine and inconvenience in connecting equipment that is meant to plug straight in. This is important for some connectors but not for all.

Just which you will want to include will depend upon your own applications, but always remember that if you need the correct connector later on it can always be fitted by simply unsoldering the wires. You pays your money and takes your pick.

Some of the holes you require for inserting the connectors might have been blocked up with solder in the flow soldering process used to mass produce the computer.

They can be easily cleared by sharpening a pencil to a very fine point, putting your soldering iron onto the offending hole and when the solder is molten remove the iron and place the pencil point in the hole.

Let the solder solidify and remove the tip. The solder will not stick to the pencil point and will leave a small hole. Wipe your iron of any excess solder and reapply it – the solder should be transferred onto the iron tip and leave the hole clean. If you cannot make this trick work then you will need a solder pump. This is a small device that has a spring loaded plunger and will suck up any molten solder leaving the hole clean.

An A/D converter allows you to connect analogue devices as inputs to the computer. The fact that this is built into the BBC Micro and its Basic is one of the more attractive aspects of this particular model.

I will also be using it in the next two exercises so you will get plenty of mileage from it. It will also allow you to connect a light pen to the computer.

The plug should be soldered into the space at the back of the board (see photo). The type you need is called a 15 way D-Type PCB mounting socket. The PCB mounting indicates that there are long bent connectors on the back so that the socket will sit at right angles to the board and the connectors will reach down into the board.

There are two types, one with a plastic built-in bracket and one with separate angle brackets. It does not matter which you use but if you use the latter you may have to run a file over one of the brackets to shorten it slightly to prevent it shorting out to C27.

Also it is a good idea to put a little nail varnish (the shade does not matter, but avoid the metallic glitter type) under where the bracket is going to contact the board. There is a varnish on the computer board to prevent the bracket shorting out the tracks but in one case I know this was slightly chipped and caused a short circuit.

The brackets may be fixed with four small nuts and bolts, the holes for which are already in place. Model B machines I have seen do not seem to have any bolts, and it would be a good idea to put some in as they will prolong the connector life.

When this is done you need to fit two ICs – IC73, a D7002 manufactured by NEC, the analogue to digital converter, and IC77 – a 74LS00. This latter chip is also used by the floppy disc drive interface (see later).

You now have a fully working four channel analogue to digital converter plus light pen input. There are also two single-bit digital inputs available for use

→

as fire buttons. Like the light pen input, only the socket needs to be provided for this function.

With the exception of the two DIN sockets next to the cassette input the remaining connectors are all flat cable PCB mounting header plugs. They are made by various manufacturers, but perhaps the most popular are the ones made by 3M called Scotchflex. I will be quoting their part number in the parts list for reference.

The use of this connecting system means that a connecting cable can be made very easily. A ribbon cable is simply squashed in a vice with the matching socket and hey presto 30-odd connections are made all at once. This is known as an insulation displacement connector – the name explains how it works.

The snag is that they are expensive.

When soldering these header plugs align all the pins in the holes carefully and turn the board over. Make one soldered joint and then, holding the board and connector between finger and thumb, apply the iron again to the joint. This will melt the solder and close up any gap that may have appeared between the plug and board.

This first joint will now hold the connector in place while you solder the rest of the pins. It is vital that the plug is in the right place in the board, as once soldered in they are virtually impossible to remove.

So check that the plug fits all the holes in that particular strip and also check with the writing on the underside of the computer case. Be comforted, however, by the fact that it takes a very special kind of twit to get it wrong.

The user port requires a 20 way plug and the VIA chip I told you about last month. If you installed it then you don't need another one. This will allow you to connect up to eight input or output digital lines to the computer for interfacing to various devices. It will be certainly much used in this column. Simply solder in the 20 way plug and that's it.

A printer is so useful it should be number one on your shopping list after the upgrade. It is much easier to follow the flow of a long program on a printout than a screen full at a time. Also you can use the computer as a word processor as well as getting a hard copy of a program's run.

For a printer connector you will need a 26 way plug and a 74LS244 buffer chip in IC70, plus the VIA chip we used earlier.

The RS423 serial interface is used to connect a serial printer to your computer and, more importantly, is a communication gateway to other computers.

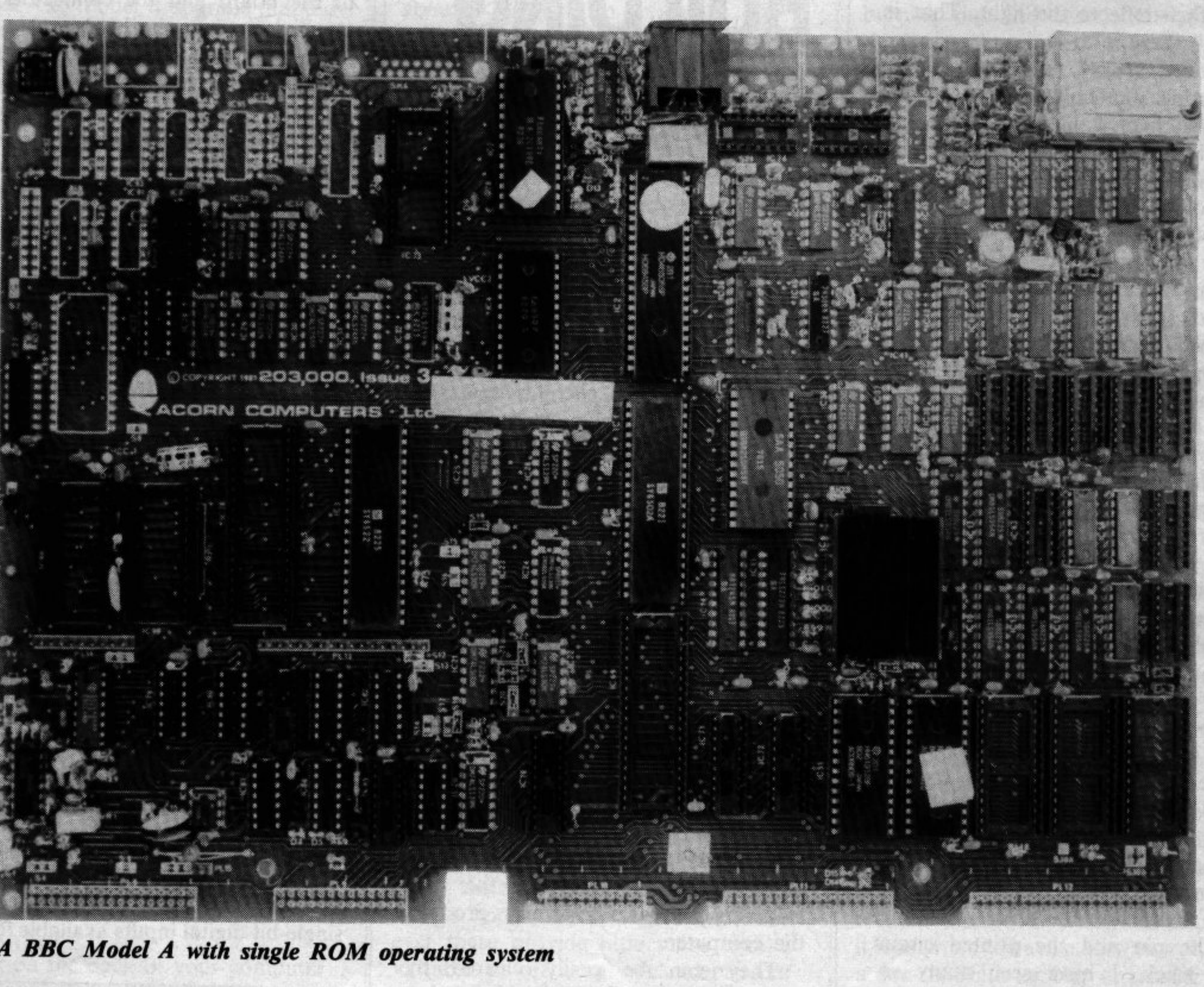
It can be connected to a modem to enable data to be transmitted over the telephone or it can connect you up to another computer for transferring data, programs or even playing multi-computer games (you and your computer against the enemy and his machine).

You will need a PCB mounting 5-way 360-degree DIN socket, which should be soldered next to the cassette DIN socket – it is of the same type. You will also need two ICs: IC74 88LS120 and IC75 DS3691, which are transmit and receive buffers.

These are the only two sockets that are positioned across the board, so you might have difficulty deciding which way round they go. Make sure pin one is on the left hand side as you look at the board from the keyboard end.

A 1 mHz bus will allow you to connect many more input/output devices to the computer, in fact a total of 512 input and 512 output devices with 8 bits per device, probably more than

→



A BBC Model A with single ROM operating system

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you will ever need.

Also with the connector you can feed audio signals into the computer to be mixed and amplified with the sound synthesiser so they will be heard on the same speaker. This will require a 34 way connector and two buffer chips – IC71 74LS244 and IC72 74LS245.

RGB output will enable you to connect the computer to an RGB input colour monitor. RGB stands for Red, Green and Blue and are the signals the monitor requires, plus a sync pulse signal. A colour monitor will give much sharper letters – especially in mode 0 – than a TV set, but it will also cost you more.

The electronics for this are already in the model A and all you require is a 6 pin DIN socket of the same type used for the cassette and RS432 connections. If you have not got a colour monitor there is obviously no need for this extra socket.

A Tube connector will allow you to connect a second, and expensive, processor to your computer. All you need is a 40 way connector, and a lot of nerve, for this is the modification that could stop your computer working.

THE BEEB BODY BUILDING COURSE

The connector goes directly to the computer's bus, and so any solder splashes or long tails left on the pins could stop your computer working. Be sure you really need this connector before you install it!

Although the model B has a connector labelled "Disc Drive" it has none of the necessary electronics behind it, so this is useless until you add the extra electronics and operating system. If you do want to put something there a 34 way connector is needed.

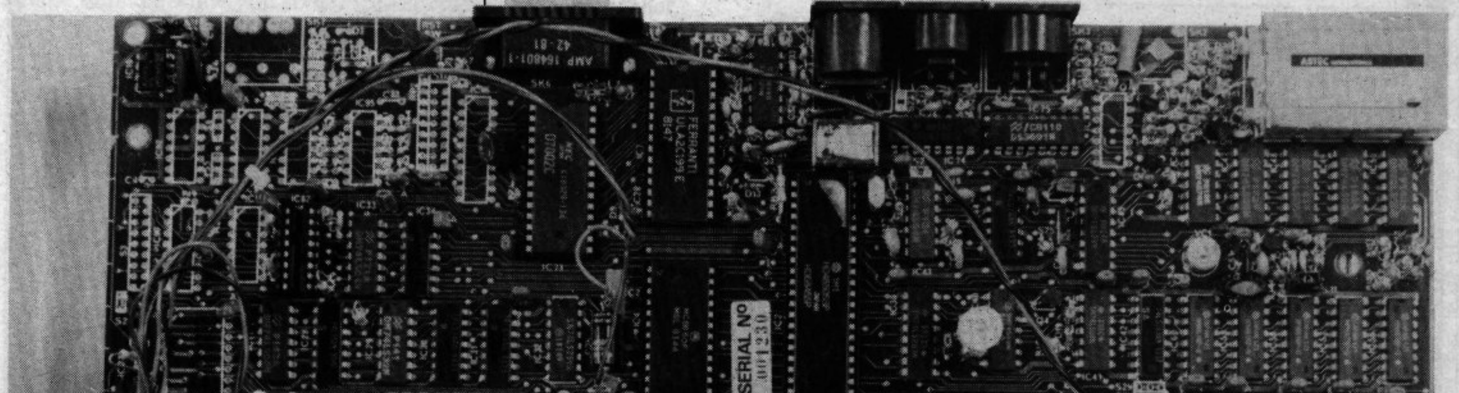
Also if you finally have the extra electronics fitted the chip IC77 from the A/D converter will also be needed. I will be returning to disc drives later in the series and will give a full explanation of what is needed for both the model A and B.

With all that installed, your model A has emerged as a fully fledged model B ready to face the remaining exercises in this series.

Next month's Exercise No. 3 . . . The joy stick joggle.

PARTS LIST

A/D CONVERTER
15 way D-Type PCB mounting connector.
IC73 – D7002 A/D converter by NEC.
IC77 – 74LS00
USER PORT
20 way plug 3M part No. 3428-1303
PRINTER PORT
26 way plug 3M part No. 3429-1303
IC70 – 74LS244
RS423 SERIAL INTERFACE
5 way 360 degree PCB mounting DIN socket.
IC74 – 88LS120
IC75 – DS3691
1 mHz BUS
34 way plug 3M part No. 3431-1303
IC71 – 74LS244
IC72 – 74LS245
RGB OUTPUT
6 way PCB mounting DIN socket
TUBE CONNECTOR
40 way plug 3M part No. 3432-1303
DISC DRIVE
34 way plug 3M part No. 3431-1303



A BBC Model B with EPROM operating system. Note there is still plenty of empty space for future expansion

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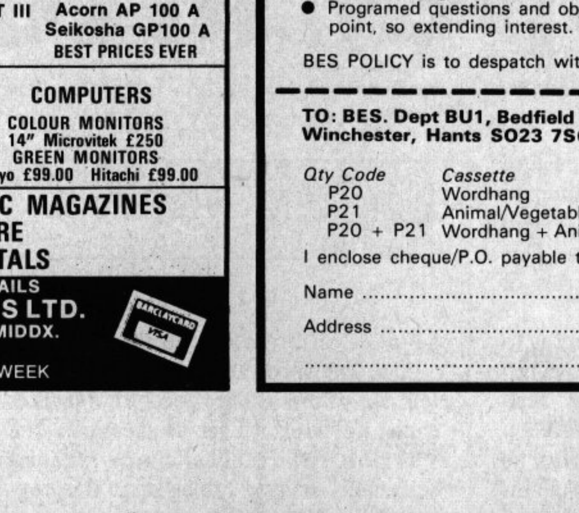

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Digging a byte deeper into Basic

By JIM NOTMAN

THE only real answer to the question "How on earth does the machine do it?", is to look at the operating system and language ROMs themselves. This is the first of an occasional series of articles on the subject.

As good a starting point as any is to look at the memory using a dump routine which prints out the hexadecimal value of the contents of each location in memory together with its Ascii equivalent. This shows where instructions, titles, error messages and keyword tables may be found.

The Basic ROM occupies addresses from &8000 to &BFFF. Its keyword table can be found between &806D and &8358. As can be seen from the table, each keyword is followed by a number &80 or greater. This is the token, the value that represents the keyword in program memory.

The keyword table, however, fails to tell us where Basic goes to interpret each keyword. This is because the "action addresses" are stored separately in two tables after the keywords.

One table, from &835A to &83CA, contains the least significant bytes of the address, and another table, from &83CB to &843B, holds the most significant byte.

To find the correct action address, Basic uses the token as an offset (a value added to a starting value), to find the memory locations where the address is stored.

The accompanying program, Tokens, will print out the keywords together with their corresponding tokens and action addresses as well as an extra byte that some routines require.

Only tokens with a value &8F and over use this action address table. The other values &80 to &8E are not included, but are interpreted as they are met in the program. For example IF has the token &E6 with the action address &9893. As it goes through its routine it will search for THEN (token 8C) and ELSE (token &8B) and deal with them as they occur.

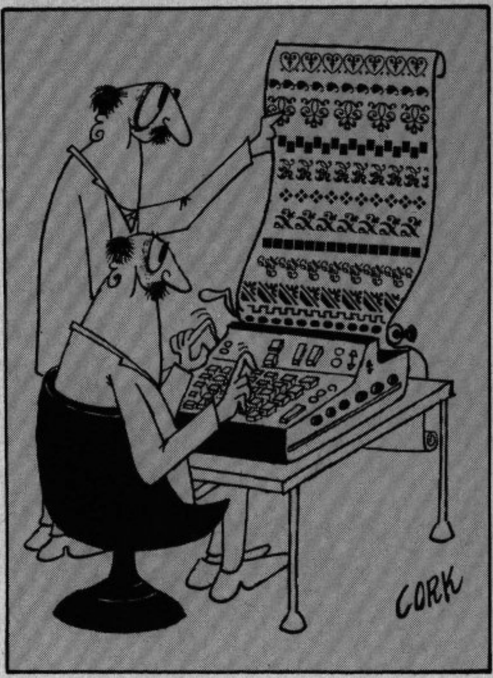
The table is also used to jump to the "Syntax Error" message at &9839 if the token &FF is used.

KEYWORDS TABLE

```
806D 41 4E 44 80  0 41 42 53 AND..ABS
8075 94  0 41 43 53 95  0 41 ..ACS..A
807D 44 56 41 4C 96  0 41 53 DVAL..AS
8085 43 97  0 41 53 4E 98  0 C..ASN..
808D 41 54 4E 99  0 41 55 54 ATN..AUT
8095 4F C6 10 42 47 45 54 9A O..BGET.
809D  1 42 50 55 54 D5  3 43 .BPUT..C
80A5 4F 4C 4F 55 52 FB  2 43 OLOUR..C
80AD 41 4C 4C D6  2 43 48 41 ALL..CHA
80B5 49 4E D7  2 43 48 52 24 IN..CHR$
80BD BD  0 43 4C 45 41 52 D8 ..CLEAR.
80C5  1 43 4C 4F 53 45 D9  3 .CLOSE..
80CD 43 4C 47 DA  1 43 4C 53 CLG..CLS
80D5 DB  1 43 4F 53 9B  0 43 ..COS..C
80DD 4F 55 4E 54 9C  1 44 41 OUNT..DA
80E5 54 41 DC 20 44 45 47 9D TA. DEG.
80ED  0 44 45 46 DD  0 44 45 .DEF..DE
80F5 4C 45 54 45 C7 10 44 49 LETE..DI
```

```
80FD 56 81  0 44 49 4D DE  2 V..DIM..
8105 44 52 41 57 DF  2 45 4E DRAW..EN
810D 44 50 52 4F 43 E1  1 45 DPROC..E
8115 4E 44 E0  1 45 4E 56 45 ND..ENVE
811D 4C 4F 50 45 E2  2 45 4C LOPE..EL
8125 53 45 8B 14 45 56 41 4C SE..EVAL
812D A0  0 45 52 4C 9E  1 45 ..ERL..E
8135 52 52 4F 52 85  4 45 4F RROR..EO
813D 46 C5  1 45 4F 52 82  0 F..EOR..
8145 45 52 52 9F  1 45 58 50 ERR..EXP
814D A1  0 45 58 54 A2  1 46 ..EXT..F
8155 4F 52 E3  2 46 41 4C 53 OR..FALS
815D 45 A3  1 46 4E A4  8 47 E..FN..G
8165 4F 54 4F E5 12 47 45 54 OTO..GET
816D 24 BE  0 47 45 54 A5  0 $..GET..
8175 47 4F 53 55 42 E4 12 47 GOSUB..G
817D 43 4F 4C E6  2 48 49 4D COL..HIM
8185 45 4D 93 43 49 4E 50 55 EM.CINPU
```

```
818D 54 E8  2 49 46 E7  2 49 T..IF..I
8195 4E 4B 45 59 24 BF  0 49 NKEY$..I
819D 4E 4B 45 59 A6  0 49 4E NKEY..IN
81A5 54 A8  0 49 4E 53 54 52 T..INSTR
81AD 28 A7  0 4C 49 53 54 C9 (..LIST.
81B5 10 4C 49 4E 45 86  0 4C .LINE..L
81BD 4F 41 44 C8  2 4C 4F 4D OAD..LOM
81C5 45 4D 92 43 4C 4F 43 41 EM.CLOCA
81CD 4C EA  2 4C 45 46 54 24 L..LEFT$
81D5 28 C0  0 4C 45 4E A9  0 (..LEN..
81DD 4C 45 54 E9  4 4C 4F 47 LET..LOG
81E5 AB  0 4C 4E AA  0 4D 49 ..LN..MI
81ED 44 24 28 C1  0 4D 4F 44 D$(..MOD
81F5 45 EB  2 4D 4F 44 83  0 E..MOD..
81FD 4D 4F 56 45 EC  2 4E 45 MOVE..NE
8205 58 54 ED  2 4E 45 57 CA XT..NEW.
820D  1 4E 4F 54 AC  0 4F 4C .NOT..OL
8215 44 CB  1 4F 4E EE  2 4F D..ON..O
```



```
821D 46 46 B7  0 4F 52 84  0 FF..OR..
8225 4F 50 45 4E 49 4E AD  0 OPENIN..
822D 4F 50 45 4E 4F 55 54 AE OPENOUT.
8235  0 50 52 49 4E 54 F1  2 .PRINT..
823D 50 41 47 45 90 43 50 54 PAGE.CPT
8245 52 8F 43 50 49 AF  1 50 R.CPI..P
824D 4C 4F 54 F0  2 50 4F 49 LOT..POI
8255 4E 54 28 B0  0 50 52 4F NT(..PRO
825D 43 F2  A 50 4F 53 B1  1 C..POS..
8265 52 45 54 55 52 4E F8  1 RETURN..
826D 52 45 50 45 41 54 F5  0 REPEAT..
8275 52 45 50 4F 52 54 F6  1 REPORT..
827D 52 45 41 44 F3  2 52 45 READ..RE
8285 4D F4 20 52 55 4E F9  1 M. RUN..
828D 52 41 44 B2  0 52 45 53 RAD..RES
8295 54 4F 52 45 F7 12 52 49 TORE..RI
829D 47 48 54 24 28 C2  0 52 GHT$(..R
82A5 4E 44 B3  1 52 45 4E 55 ND..RENU
82AD 4D 42 45 52 CC 10 53 54 MBER..ST
82B5 45 50 88  0 53 41 56 45 EP..SAVE
82BD CD  2 53 47 4E B4  0 53 ..SGN..S
82C5 49 4E B5  0 53 51 52 B6 IN..SQR.
82CD  0 53 50 43 89  0 53 54 .SPC..ST
82D5 52 24 C3  0 53 54 52 49 R$..STRI
82DD 4E 47 24 28 C4  0 53 4F NG$(..SO
82E5 55 4E 44 D4  2 53 54 4F UND..STO
82ED 50 FA  1 54 41 4E B7  0 P..TAN..
82F5 54 48 45 4E 8C 14 54 4F THEN..TO
82FD B8  0 54 41 42 28 8A  0 ..TAB(..
8305 54 52 41 43 45 FC 12 54 TRACE..T
830D 49 4D 45 91 43 54 52 55 IME.CTRU
8315 45 B9  1 55 4E 54 49 4C E..UNTIL
831D FD  2 55 53 52 BA  0 56 ..USR..V
8325 44 55 EF  2 56 41 4C BB DU..VAL.
832D  0 56 50 4F 53 BC  1 57 .VPOS..W
8335 49 44 54 48 FE  2 50 41 IDTH..PA
833D 47 45 D0  0 50 54 52 CF GE..PTR.
8345  0 54 49 4D 45 D1  0 4C .TIME..L
834D 4F 4D 45 4D D2  0 48 49 OMEM..HI
8355 4D 45 4D D3  0 50 EF E3 MEM..P..
```

ACTION ADDRESSES

KEYWORD	TOKEN	ACTION ADDRESS	EXTRA BYTE
AND	80		0
ABS	94	ADBD	0
ACS	95	A8C6	0
ADVAL	96	AB56	0
ASC	97	ACC4	0
ASN	98	A8CC	0
ATN	99	A907	0
AUTO	C6	905F	10
BGET	9A	BF78	1
BPUT	D5	BF61	3
COLOUR	FB	9346	2
CALL	D6	8E6C	2
CHAIN	D7	BF33	2
CHR$	BD	B3EE	0
CLEAR	D8	9326	1
CLOSE	D9	BF9E	3
CLG	DA	8E57	1
CLS	DB	8E5E	1
COS	9B	A989	0
COUNT	9C	AF26	1
DATA	DC	8AED	20
DEG	9D	ABE7	0
DEF	DD	8AED	0
DELETE	C7	8ECE	10
DIV	81		0
DIM	DE	90DD	2
DRAW	DF	93A5	2
ENDPROC	E1	9310	1
END	E0	8A50	1
ENVELOPE	E2	B49C	2
ELSE	8B		14
EVAL	A0	AC12	0
ERL	9E	AFCE	1
ERROR	85		4
EOF	C5	ACDE	1
EOR	82		0
ERR	9F	AFD5	1
EXP	A1	AAB4	0
EXT	A2	BF4F	1
FOR	E3	B7DF	2
FALSE	A3	AEF9	1
FN	A4	B1C4	8
GOTO	E5	B8EB	12
GET$	BE	AFEE	0
GET	A5	AFE8	0
GOSUB	E4	B8B4	12
GCOL	E6	932F	2
HIMEM	93	AF32	43
INPUT	E8	BA62	2
IF	E7	9893	2
INKEY$	BF	B055	0
INKEY	A6	ACD3	0
INT	A8	AC9E	0
INSTR(	A7	AD08	0
LIST	C9	B5B5	10
LINE	86		0
LOAD	C8	BF2D	2
LOMEM	92	AF2B	43
LOCAL	EA	92D5	2
LEFT$(	C0	AFFB	0
LEN	A9	AF00	0
LET	E9	8B57	4
LOG	AB	ABCD	0
LN	AA	A804	0
MID$(	C1	B068	0
MODE	EB	935A	2
MOD	83		0
MOVE	EC	93A1	2
NEXT	ED	B6AE	2
NEW	CA	8A7D	1
NOT	AC	ACF7	0
OLD	CB	8A3D	1
ON	EE	B934	2
OFF	87		0

→

From Page 67

OR	84		0
OPENIN	AD	BF85	0
OPENOUT	AE	BF81	0
PRINT	F1	8D33	2
PAGE	90	AEEF	43
PTR	8F	BF50	43
PI	AF	ABF0	1
PLOT	F0	93AE	2
POINT(	B0	AB64	0
PROC	F2	92B6	A
POS	B1	AB92	1
RETURN	F8	B8D5	1
REPEAT	F5	BBFF	0
REPORT	F6	BFE6	1
READ	F3	BB39	2
REM	F4	8AED	20
RUN	F9	BD29	1
RAD	B2	ABD6	0
RESTORE	F7	BB00	12
RIGHT$(	C2	B01D	0
RND	B3	AF78	1
RENUMBER	CC	BF37	10
STEP	88		0
SAVE	CD	BEFA	2
SGN	B4	ABAD	0
SIN	B5	A994	0
SQR	B6	A7B4	0
SPC	89		0
STR$	C3	B0C3	0
STRING$(	C4	B0F1	0
SOUND	D4	B461	2
STOP	FA	8A59	1
TAN	B7	A6C9	0
THEN	8C		14
TO	B8	AF0B	0
TAB(	8A		0
TRACE	FC	9243	12
TIME	91	AEE3	43
TRUE	B9	ACEA	1
UNTIL	FD	BBCC	2
USR	BA	ABFB	0
VDU	EF	93EF	2
VAL	BB	AC55	0
VPOS	BC	AB9B	1
WIDTH	FE	B4CC	2
PAGE	D0	9239	0
PTR	CF	BF39	0
TIME	D1	927B	0
LOMEM	D2	9224	0
HIMEM	D3	9212	0

TOKENS PROGRAM

```
   10  REM Jim Notman March 1983
   20 MODE7
   30 VDU14
   40 PRINT'"KEYWORD    TOKEN   ACTION
 EXTRA"
   50 PRINT"                        ADDRESS
BYTE"'
   60 ADDRESS=&806D
   70 LO_BYTE=&82CB
   80 HI_BYTE=&833C
   90 REPEAT
  100 REPEAT
  110 PRINTCHR$(?ADDRESS);
  120 ADDRESS=ADDRESS+1
  130 UNTIL ?ADDRESS>&7F
  140 PRINTTAB(13);~?ADDRESS;
  150 IF ?ADDRESS>=&8F THEN PRINTTAB(20)
;~(?(HI_BYTE+?ADDRESS)*256)+(?(LO_BYTE+?
ADDRESS));
  160 PRINTTAB(30);~ADDRESS?1
  170 ADDRESS=ADDRESS+2
  180 UNTIL ADDRESS>&8358
  190 VDU15
```

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Although similar to Educational - 1 this tape is more advanced and aimed at 7 to 12 year olds. The tape includes MATH1, MATH2, AREA, MEMORY (Model B only), CUBECOUNT and SPELL.

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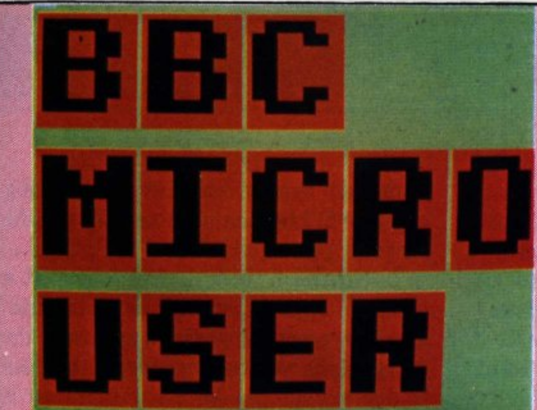

WIN a year's supply of software!

IF you are among the hordes of people who wrote to BBC Micro User following last month's issue to defend our "resident genius" – you needn't have bothered. He's the managing director's nephew or something.

Anyway, the result, after all the smoke had cleared, was that dear Percival has been whisked away to the Bahamas "to recover" while I am left here doing all the dirty work.

The first thing I had to do was to update the program you see listed below – one of Percival's. It's the header for our cassette of programs from the pages of BBC Micro User and proclaims "BBC Micro User – March 1983" loudly to the world. At least it did until I changed March to April.

That's when I realised that dear Percival had done it again. If you run the program you'll see what I mean. If the name of the month has more than five letters the whole display is ruined.

I have tried to alter it, but I can't make head or tail of the thing. And that's where you come in. I was terribly impressed with the amount of skill you all showed in our last contest. So for this month's competition could you replace Percival's header with a program of your own – one that tells the world the tape is from BBC Micro User?

You can change Percy's as much as you want. You can do as many clever things as you want, too. But PLEASE will you send some notes along to explain what you're doing. Remember, it's got to work for all the months of the year. Oh, and while you're at it, could you give us a fanfare or something?

Your reward for all this effort? The winner will receive a box of software every month for the next year.

The software will be selected from the ever-growing range marketed by Acornsoft, the software division of Acorn Computers. It includes the highly rated implementation of Forth for the BBC Micro, as well as many of Acornsoft's top games.

The last date for the receipt of entries is April 29, 1983. The result of the contest will be given in June's BBC Micro User.

```
   10 REM *************
   20 REM *** BBC   ***
   30 REM *** MICRO ***
   40 REM *** USER  ***
   50 REM *** APRIL ***
   60 REM *** 1983  ***
   70 REM *************
   80 MODE 5
   90 PROCINIT
  100 A$(1)="BBC"
  110 A$(2)="MICRO"
  120 A$(3)="USER"
  130 A$(4)="APRIL"
  140 A$(5)="1983"
  150 PROCWORD(A$(1),0,2)
  160 PROCWORD(A$(2),0,12)
  170 PROCWORD(A$(3),0,22)
  180SOUND &11,0,0,1
  190 FOR I%=1 TO 8000:NEXT I%
  200 CLS
  210 PROCWORD(A$(4),0,4)
  220 PROCWORD(A$(5),4,16)
  230 SOUND &11,0,0,1
  240 FOR I%=1 TO 8000:NEXT I%
  250 MODE 6
  260 END
  270 REM ============================
  280 DEF PROCWORD( A$,XPOS%,YPOS%)
  290 LOCAL R%,X%,Y%,CODE%,F%
  300 VDU5
  310 X%=XPOS%*HSTEP%:Y%=1023-YPOS%*VSTE
P%
  320 FOR R%=1 TO LEN(A$)
  330 CODE%=ASC(MID$(A$,R%,1))
  340 F%=49408+(CODE%-64)*8
  350 PROCLETTER (X%,Y%,F%)
  360 X%=(XPOS%+R%*8)*HSTEP%
  370 NEXT R%
  380 VDU 4
  390 ENDPROC
  400 REM ============================
  410 DEF PROCLETTER(X%,Y%,F%)
  420 PROCBLOCK(X%,Y%)
  430 LOCAL H%,V%,I%,J%,K%,A%
  440 V%=Y%
  450 FOR I%=0 TO 7
  460 H%=X%
  470 K%=256:A%=?(F%+I%)
  480 FOR J%= 0 TO 7
  490 K%=K%/2
  500 MOVE H%,V%
  510 IF (K% AND A%)=K% THEN VDU 224:SOU
ND&11,-15,RND(255),-1
  520 H%=H%+HSTEP%
  530 NEXT J%
  540 V%=V%-VSTEP%
  550 NEXT I%
  560 ENDPROC
  570 REM ============================
  580 DEF PROCINIT
  590 VDU 19,2,0,0,0,0
  600 VDU 19,3,2,0,0,0
  610 VDU 23,224,240,240,240,240;240,240
,240,240
  620 HSTEP%=32:VSTEP%=32
  630 COLOUR 131
  640 CLS
  650 DIM A$(5)
  660 ENDPROC
  670 REM ============================
  680 DEF PROCBLOCK(X%,Y%)
  690 GCOL0,1
  700 X%=X%+16
  710 Y%=Y%+16
  720 MOVE X%,Y%:MOVE X%,Y%-17*16
  730 PLOT 85,X%+15*16,Y%
  740 PLOT 85,X%+15*16,Y%-17*16
  750 GCOL0,2
  760 ENDPROC
```

ACORNSOFT GAMES
Sphinx Adventure

This is what awaits the winner of this month's contest – one new box of software every month for the next year

Your FREE entry form

My cassette and listing for the BBC software competition is enclosed, plus a stamped addressed envelope for its return.

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Address ....

....

....

Tel: No. ....

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68 Chester Road, Hazel Grove, Stockport SK7 5NY.

Let Gipsy Microlengro cast your horoscope

MORE and more people are coming into contact with computers at home and at their place of work, most of them not in any way experts but only want to use the computer as a tool.

So ease of operation is important. Operator errors must be trapped, "the program must go on."

Crash proof programs require clear prompts and careful input validation. If you want the date to be typed in, it should be requested in three parts:

"Type in the date"
"year including century . . ."
"month of the year . . . ."
"day of the month . . . ."

Each entry must be checked so that unacceptable data is not used, that entry being repeated.

It is also important that input routines are standardised. Pressing the RETURN key should signal the end of each input, whether INPUT or GET or INKEY has been used in the program.

To demonstrate these techniques, here is a program that prints out your horoscope after you have entered your date of birth. As a bonus it also tells you the day of the week you were born on.

You can alter the message if you wish in accordance with your daily newspaper. Actually it wouldn't be too hard to adapt it so that the messages are input at the beginning of the program, perhaps from tape.

The program was originally written as a fund-raiser for an autumn fair and had to operate with the minimum of supervision. Names and dates of birth were typed into the computer which then gave the next week's horoscope along with the day of the week on which the user was born.

Unbeknown to the punter, all the data entered was saved onto a cassette file, so that a survey of the users could be made. So beware – information given in all innocence may be used for other purposes.

The program contains an input routine for integers that checks each character as it is typed to see if it is a number. Typists are used to using capital "O" for the number "0" and the letter "l" for the number "1".

If either of these letters is typed a message appears on the screen explaining the error of their ways and the entry is allowed to continue. If the data is not acceptable an error message is displayed and the request for data entry repeated.

The integer input routine is from lines 2700 to 2920.

2710 Defines the variables which are not available outside the procedure.

2720 FL=0 means that the integer still has no figures.

2730 Empties the keyboard buffer.

2740 Gets characters from the keyboard and returns their Ascii codes until at least one number has been typed and the RETURN key pressed.

2750 Checks to see if the character has the Ascii code of a number. Numbers give values of Y between &2F and &3A, 48 to 57. So 48 is subtracted from Y to give the number typed. For ease of constructing the integer, Y-48 is changed into a string and the character is then printed.

2760 If Y=&7F the DELETE key has been pressed so the last character printed must be deleted from the screen and the string.

2770 Examines Y to see if a capital 'A' or a lower case 'l' has been typed.

2780,2790 Sets E appropriate to the key pressed in error.

2800 &OD is the code of the

RETURN key. When it is generated inside the program it moves the cursor to the beginning of the current line. It does not cause a linefeed, so a cursor down &OA character must also be printed. &O7 causes a beep to attract the operator's attention to the error.

2810 Prints a message saying which key had been pressed in error.

2820 INKEY(500) is a simple delay which can be interrupted and the key pressed interpreted to see if it was a valid input.

2830 Deletes the message by printing three blank lines.

2840 Moves the cursor back to where the number was printed.

2850 If the key which interrupted the delay was a recognisable character it is passed to 2750 for evaluation.

2860 Checks to see that the number is less than 9999 by counting the number of digits in the number. If the number is too big a message is printed.

2870,2880 Zeroes the integer, sets FL=0 once more, clears the message and starts the input of characters again.

2910 Converts the string into an integer.

2920 End of the routine.

The days of the week are accurate back to September 14, 1752, when the Gregorian calendar was adopted. If you add 11 days on to earlier dates then the program will tell you what day of the week it was. On what day of the week was the Battle of Hastings?

PROGRAM FORMAT

50 Initialises the system integer variables.

60-80 Sets up the days of the week.

110-260 Inputs and validates today's date.

270-320 Writes the screen and opens text window.

330 Defines the number of goes before you need to restart.

340 Dimensions the arrays which store the data.

370-570 Inputs your name and date of birth.

580-620 Calculates age and day on which you were born.

630-780 Calculates starsign and printing of horoscope.

1130-2400 Horoscopes.

MAIN PROCEDURES

PROCInteger Ensures only numbers are inputted.

PROCMONTH Verifies that either the name or the number of a month has been entered.

PROCDAY Checks that a valid number of days has been entered.

PROCWHATDAY Calculates the day of the week which has been entered.

MAIN VARIABLES

B% This day. **C%** This month. **D%** This year. **E%** Day of birth. **M%** Month of birth. **Y%** Year of birth.

E set =1 when the input needs redoing.

FL set =1 when one number being typed in has one or more digits.

Goes the number of participants before a reset is needed.

Today$ today's date.

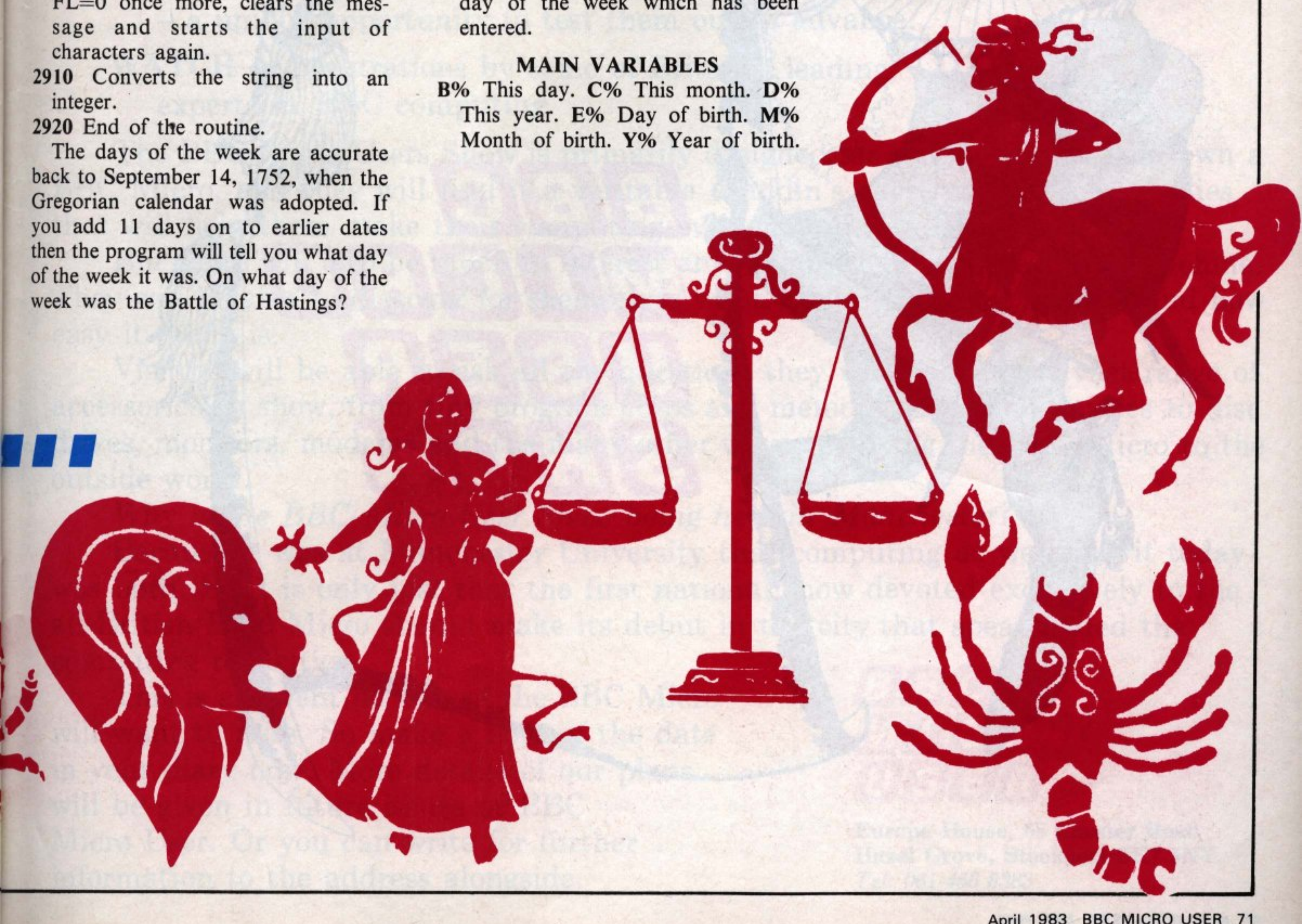
NAME$(I%) ,BIRTH$(I%) Participant's name and date of birth.

Rather than waste space by printing out the horoscopes for all the signs, we have only included in the listings the 10 lines of the subroutine for Aries (1140 to 1230). The other routines follow much the same pattern, and you can enter your own messages:

Taurus 1240 to 1330
Gemini 1340 to 1420

and so on for Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius and Pisces as determined by PROCstar. The complete program is, of course, included in this month's cassette (see Page 55).

HOROSCOPE LISTING STARTS ON PAGE 93



Announcing the FIRST of BBC

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The date – Friday, Saturday, Sunday, June, 24, 25, 26, 1983
The place – Renold Building, UMIST, Manchester

AT LAST – a national show exclusively for users of the BBC Micro! An action-packed, three-day event that has one main aim . . . to ensure users from all over the country are brought fully up to date with all the exciting developments in this most remarkable machine.

INSPECT the latest hardware devices that add greater power and more versatility to the BBC Micro.

TRY OUT the yet-to-be released summer crop of games – a unique opportunity to test them out in advance.

WATCH demonstrations by some of Britain's leading experts in BBC computing.

The BBC Micro Users Show is primarily designed for people who already own a BBC Micro, and they will find it a veritable Aladdin's cave, packed with goodies that will help them make their computing even more rewarding.

But there will also be much to interest anyone about to buy their first machine. They will be able to discover for themselves what computing is all about – and how easy it really is.

Visitors will be able to ask all the questions they want about the vast range of accessories on show, from tiny program chips and memory expansion devices to disc drives, monitors, modems and the many other ways of linking the BBC Micro to the outside world.

Why is the BBC Micro User Show being held in Manchester?

Because it was at Manchester University that computing as we know it today was born. So it is only just that the first national show devoted exclusively to the all-British BBC Micro should make its debut in the city that spearheaded the computing revolution.

This is an event no user of the BBC Micro will want to miss. So make a note of the date in your diary now. More details of our plans will be given in future issues of BBC Micro User. Or you can write for further information to the address alongside.

BBC MICRO USER

Europa House, 68 Chester Road
Hazel Grove, Stockport SK7 5NY.
Tel: 061-456 8383

Bits & Bytes

WELCOME to Bits and Bytes, the first in a series of articles in which we hope to take the mystery out of understanding the fundamentals of the BBC Micro's workings.

All too often even competent Basic programmers tend to shy off such topics as binary coding, hexadecimal and assembly language because it seems too "mathematical".

This is a great pity, because the BBC Micro is so constructed that a little knowledge in these fields allows you to take full advantage of its advanced facilities.

The mathematical aspects of the subject aren't at all deep – certainly anyone who can follow Basic should be able to cope with this series.

If you feel that despite our best efforts we still haven't explained something fully enough, please write in and tell us – we'll try to rectify the situation in later articles.

First we are going to look at binary code – a way of handling numbers essential to our understanding of what goes on inside a computer.

Number code

Binary is just a way of coding numbers in a way particularly suitable for computers. It's actually quite simple. What often confuses beginners is the fact that the binary system codes numbers in a way that can look extremely like the way we normally code numbers.

For example, if you were presented with a number 100, you would probably decode it in your normal way and say it was "one hundred".

That, however, is just one way of interpreting it. If you decided to decode it as a binary number, you would interpret 100 in a completely different way and say it meant the number "four." *(Never mind exactly how you arrived at that conclusion for the moment.)*

This is what often causes problems – people are so used to dealing with their numbers in the normal way that 100 is always "one hundred" to them, and they can't make the shift necessary to decode it in binary as "four".

Actually it is rather ambiguous. Presented with 100, do you interpret it as "one hundred" or "four" ? Our rule will be, if you mean our usual way of dealing with numbers *(the hundreds, tens and units you learnt at school – or to put it more formally, the denary system)* you write the number in the normal way.

If you wish the number to be decoded as a binary number you put the symbol % in front of it – 100 means "one hundred" while %100 means "four".

So far so good. We now have a marker (%) to warn us that we have to decode the number in a special way as a binary number.

Decoding rule

However, before you decode you need a rule for decoding – so how do you get the number "four" from %100? What's the rule?

Let's take a detour for the moment, and think about the coins we use every day. Our currency consists of these coins:

50p, 20p, 10p, 5p, 2p and **1p** (ignoring the half-pence). We can combine them to give any sum we wish: For example:

75p is **50p + 20p + 5p**

or **50p + 10p + 10p + 5p**

and so on. We are all familiar with this – often we use multiples of coins to make up a sum. For example, 5p can be **2p + 2p + 1p**

Using the same coin twice, though, often means that we end up carrying unnecessary amounts of change, and I for one don't like doing that.

Sometimes, however, with our present coinage system we have to use the same coin twice to obtain certain sums. You cannot, for instance, make up the sum of 4p without doubling up coins. To avoid repeating coins we would have to invent a 4p coin!

Let's do that; in fact, let's invent a coinage system where you never have to use the same coin twice.

First of all we would need a **1p** coin and, of course, a **2p** coin, because we cannot use **1p + 1p** for 2p – it breaks the rule!

Now 3p can be made up of **1p + 2p**, but for 4p we'll have to invent a **4p** coin.

Equipped with that we can make 5p (**4p + 1p**), 6p (**4p + 2p**), and 7p (**4p + 2p + 1p**). In obtaining 7p we used all our available coins, so now we have to invent an **8p** coin. If you work it out (and I suggest you have a go) you will find that with the coins you have at your disposal (**8p, 4p, 2p, 1p**) you can make any sum up to 15p. Then you would have to invent a new coin, **16p**.

Notice how the coins we have created have doubled in value: **1p, 2p, 4p, 8p, 16p.** No prizes for guessing what the next one is.

Little change

Let's summarise our results in a table (Figure I). Here I have used the columns to show the coins available and the rows to show how the various totals are made up. A 1 in a particular column means that we use that column's coin, and 0 means that we don't use it. Look at the row for 5p. It has 101 on it. According to our rule, this means we pick out the coins **4p** and **1p** (and NOT **2p**) to make up the 5p total.

	4p	2p	1p
%	**1**	**0**	**1**

→ 4p + 1p = 5p

Now let's get back to computers by dropping all this talk about coins and redraw Figure I to show the same information but without referring to money – just numbers. Figure II is the new table.

As you can see, there is little change, and we can use this table to encode numbers in general, not just coins. We call this method of encoding the binary system.

Remember, to show that we

TOTALS	COINS			
	8p	4p	2p	1p
1p				1
2p			1	0
3p			1	1
4p		1	0	0
5p		1	0	1
6p		1	1	0
7p		1	1	1
8p	1	0	0	0
9p	1	0	0	1
10p	1	0	1	0
11p	1	0	1	1
12p	1	1	0	0
13p	1	1	0	1
14p	1	1	1	0
15p	1	1	1	1

Figure I

Denary Value	Column 8	4	or Bit Values 2	1	Binary Value
1				1	%1
2			1	0	%10
3			1	1	%11
4		1	0	0	%100
5		1	0	1	%101
6		1	1	0	%110
7		1	1	1	%111
8	1	0	0	0	%1000
9	1	0	0	1	%1001
10	1	0	1	0	%1010
11	1	0	1	1	%1011
12	1	1	0	0	%1100
13	1	1	0	1	%1101
14	1	1	1	0	%1110
15	1	1	1	1	%1111

Figure II

By MIKE BIBBY

mean a binary number we precede it with %. So if you see, for example, %101 means:

4 2 1
% 1 0 1
→ 4 + 1 = ***5***

i.e. we add together the values of the columns containing 1. Look at row 5 of the table to check it.

Similarly, %1101 would mean 13 in the denary system since

8 4 2 1
% 1 1 0 1
→ 8 + 4 + 1 = ***13***

By now you should be able to work out for yourself why %100 represents four.

From the table, or by using the addition method I've just illustrated, see if you can decode the denary values of the following binary numbers:

%1001
% 101
% 11
%1101
% 111

You can use the program accompanying this article to check your results.

You've probably noticed by now that in the binary system you only use two symbols, 0 and 1, to encode numbers – hence binary, bi– for two as in bicycle.

You can encode any number that you want in binary – just use more columns (or "bits" as we say in computer jargon), remembering that each new bit is worth double the preceding bit.

However it does get terribly cumbersome. For example, 100 (denary) encoded in binary is %1100100 since

64 32 16 8 4 2 1
% 1 1 0 0 1 0 0
→ 64+32+4=*100*

It is much easier to handle the number in our normal system.

To a computer this presents no problem, and the fact that binary only uses two symbols is a bonus because you can represent numbers with a sequence of "switches".

Switches are what we call "two state" – they're either ON or OFF.

If we have a sequence of four switches together we can encode numbers by having them either ON or OFF. We could use ON to mean a 1, and OFF to mean a 0 in a particular column:

8 4 2 1
ON OFF ON ON
→ %1011=*11*

Each of these "switches" represents a bit, and a computer memory is full of bits. The 6502, which is the microprocessor at the heart of the BBC system, deals with 524,288 of them.

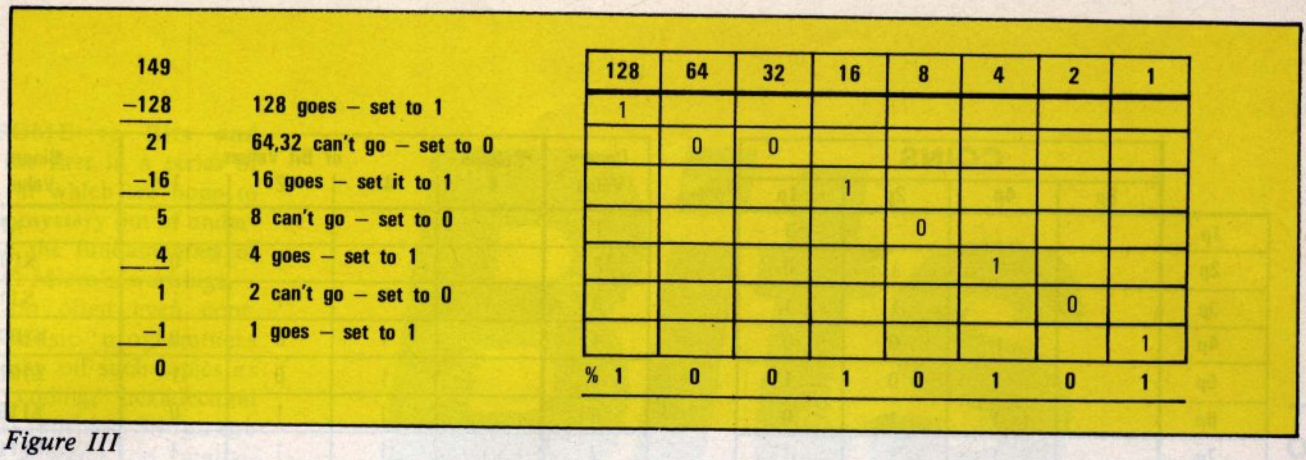
To make things simpler, the 6502 handles the bits in groups of eight bits at a time – the group of eight being called a byte.

With this type of organisation the largest number you can store in a byte is 255 since

128 64 32 16 8 4 2 1
% 1 1 1 1 1 1 1 1
→ 128+64+32+16+8+
4+2+1=*255*

Of course the computer can handle larger numbers *(and not just whole numbers)* but to do so it must use more than one byte.

Converting a byte from binary to denary is fairly straightforward. Simply write it down under the appropriate column (or bit) values and add



```
 149
−128    128 goes – set to 1
  21    64,32 can't go – set to 0
 −16    16 goes – set it to 1
   5    8 can't go – set to 0
   4    4 goes – set to 1
   1    2 can't go – set to 0
  −1    1 goes – set to 1
   0
```

128	64	32	16	8	4	2	1
1							
	0	0					
			1				
				0			
					1		
						0	
							1
% 1	0	0	1	0	1	0	1

Figure III

From Page 69

together the value of all the columns in which a 1 occurs. For example, given %10010101 you translate as follows:

128 64 32 16 8 4 2 1
% 1 0 0 1 0 1 0 1
→ 128+16+4+1=*149*

Going from denary to binary is not at all difficult, but it is rather hard to put into words.

You do it by subtracting from the number you want to encode the value of each column in turn, starting with the highest (i.e. 128, 64, 32 and so on).

If you can subtract a particular column value you put a 1 in that column and continue to subtract the next lower column value from the remainder.

If you cannot manage the subtraction you put a 0 in that column and try to repeat the subtraction with the next lower column number.

So, starting with the highest column number (128 in our case), you:

```
REPEAT
  1. Attempt to subtract the relevant column number (highest first).
  2. IF you succeed then put a 1 in that column number and continue to subtract other columns from the remainder. ELSE put a 0 in that column.
UNTIL all eight columns are covered.
```

Figure III should make it clearer.

In practice, when faced with encoding a number from denary to binary I tend to do it in my head, seeing which column values will add together to make the sum required, starting with the highest first.

For example, if I were to encode 161 in binary I would say, "Well, I can use 128, so that leaves me 33 to find. 33 can be made up of 32 and 1 so that does it: 128+32+1=161. So I encode it as:

128 64 32 16 8 4 2 1
% 1 0 1 0 0 0 0 1
= %10100001

After a while you'll find this way quite simple.

To finish off, I'll leave you with a program to print out the binary value of a number between 0 and 255 (i.e. that can be stored in one byte). Try it with various values and see if you can accept the results.

The program itself uses one or two ideas, such as AND, that may not be too familiar to you as yet.

Worry not, "Bits and Bytes" will cover them. Watch this space . . .

```
10 REM *********************
20 REM * BBC MICRO USER '83 *
30 REM *********************
40 MODE 7
50 ON ERROR GOTO 230
60 REPEAT
70 *FX 15,1
80 CLS
90 @%=4
100 REPEAT
110 PRINT TAB(0,5)CHR$(130)
120 PRINT TAB(1,5);STRING$(15," ")
130 INPUT TAB(1,5)"Denary "denary%
140 UNTIL denary%>=0 AND denary%<256
150 PRINT TAB(1,12)"%"
160 FOR I%= 7 TO 0 STEP -1
170 PRINT TAB(30-4*I%,10)2^I%
180 PRINT TAB(30-4*I%,12)(2^I% AND den
ary%)/2^I%
190 NEXT
200 PRINT TAB(0,20);CHR$(132)CHR$(157)
CHR$(131)"SPACE TO CONTINUE,ESCAPE TO EN
D"
210 REPEAT UNTIL INKEY(-99)
220 UNTIL FALSE
230 @%=10:END
```

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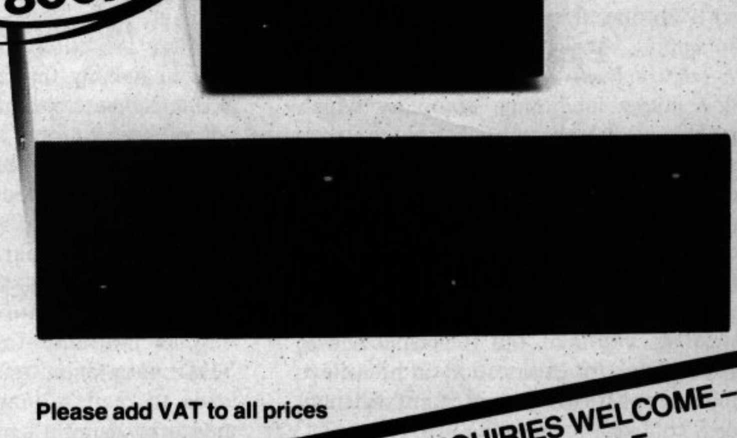

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COMPUTER INTERFACING

DAVID DUFF looks at the BBC Micro's role as a powerful research and control tool when linked up to the home, the lab, the factory

I REMEMBER the day I first heard of the new kind of chip called a microprocessor. I was, at the time, a fairly young science teacher interested in electronics and getting to grips with the new gates and counters packaged in woodlouse-like containers.

When the new device was mentioned I asked what it was and was told it was a new big chip that was software controlled. Knowing nothing about software and already overawed by the complexity of big chips, I felt dispirited and hoped secretly that this new technology would never catch on.

For the next year or two, my few encounters with the new device did little to improve my understanding, but were a positive help to my sense of humour.

I remember many occasions when the sight of complicated circuit boards programmed to do simple tasks by means of complicated instructions reduced me to a state of mirth and disbelief. Fortunately, it was not long before the first microcomputers appeared in schools and I learned to appreciate the significance and power of software-based systems.

Exploration

A move later to a company which makes electrical and electronic equipment for science teaching provided an excellent opportunity to explore a particularly important aspect of microcomputer use, that of interfacing to the real world.

Keyboards and VDUs are, of course, types of interface, but the aspects that seemed ripe for exploration and development concerned measurement, display and control.

Now you do not need a computer and interface to measure sound level, temperature, pressure and so on. Nor do you need one to reverse a model car when switches on its bonnet indicate that it has run into a large obstacle.

But a computer has a number of features and facilities which are invaluable to any measuring and control instrument once some means is provided for getting the required information in and out.

There are criteria that I feel must be used in judging the value of a computer and interface combination. Our world is full of conventional instrumentation of all kinds and it will be some time before this will be discarded in favour of more versatile software controlled instruments.

Efficiency

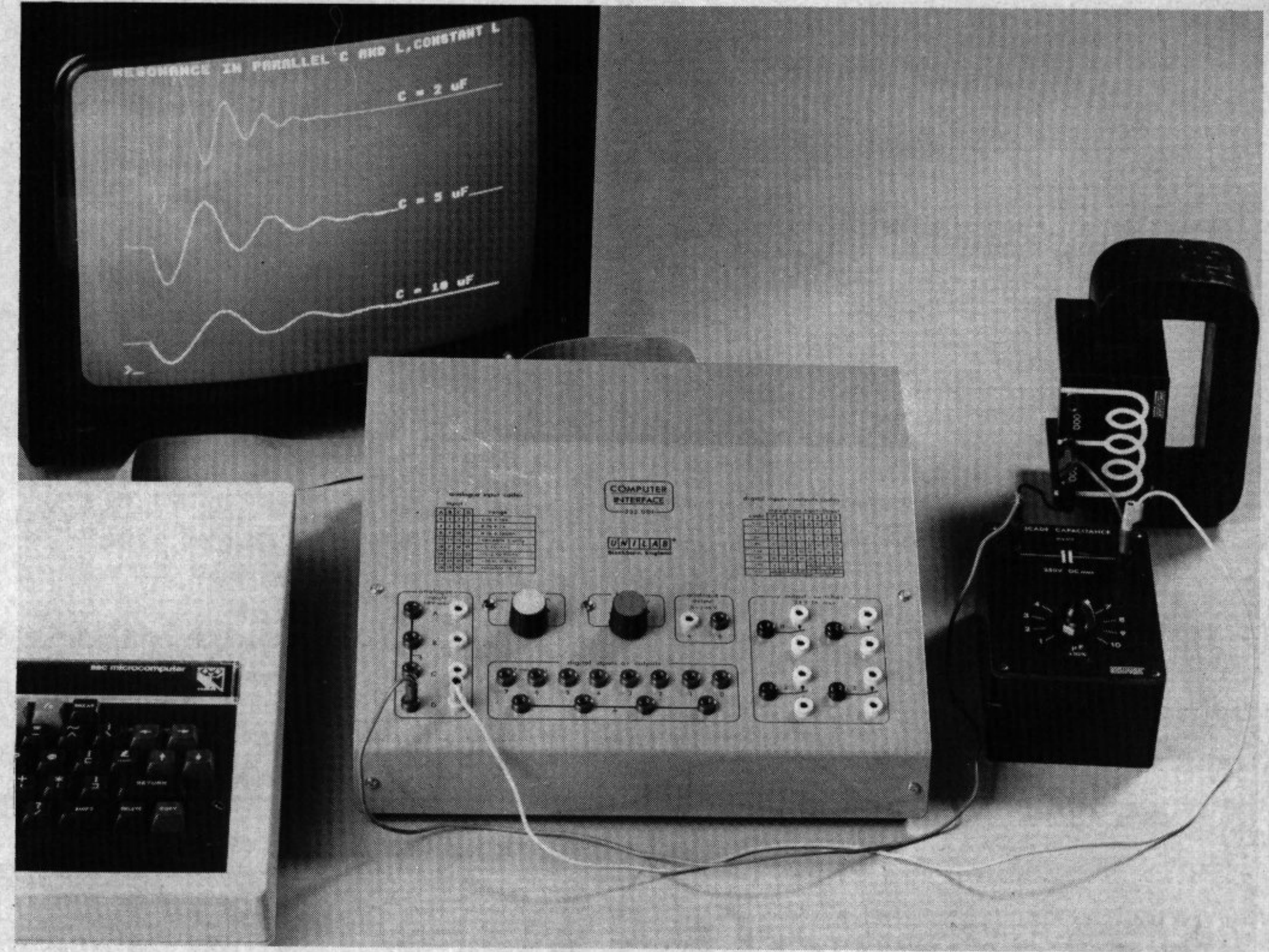
It is nonsense to use a computer, VDU, interface, cassette machine and leads to read a quantity that could be measured using a simple voltmeter. The **first criteria then is that the interface** and computer must enable you to do something you would not otherwise be able to do as easily or cheaply. The second criteria leads naturally from the first, and is that the interface should make efficient use of the special facilities granted by a computer.

Such facilities are:

- Ability to capture data at a very high speed
- Ability to store and recall large quantities of data
- Ability to process and display data in a very wide variety of ways
- Ability to make decisions on the basis of input data and to modify outputs accordingly.

Most physical quantities such as temperature, sound level, pressure and light intensity can be converted into corresponding voltages. For example, a photocell produces an output voltage which depends on the intensity of light falling on its surface (the basis of the photographic exposure meter).

The interface must contain, therefore, an analogue to digital converter to change these voltages into digital values for passing to the computer. Ideally, this



A versatile input/output interface in use as a storage oscilloscope

will convert inputs at least as quickly as the computer can read them. In the case of the BBC Micro we will be looking for a conversion rate of around 125000 samples a second.

While conventional A to D converters can plot the light output from a burning match, this fast unit would be able to plot the light output from an electronic flash.

The facility to be able to sample analogue data very rapidly opens up a whole new perspective on the world around us, especially if the interface provides a number of analogue input channels which can be read in quick succession.

Many events are already digital in nature. The closing of a switch and the operation of a thermostat are digital events which the interface can pass directly to the computer. The prudent user will be keen that the digital inputs have some form of protection fitted to eliminate the possibility of damage to equipment caused by excessively high input voltages.

Information input to the computer can be used as it stands, perhaps being processed to produce tables of results or plotted as a graph so making the system operate as a high resolution storage oscilloscope.

Sophistication

However, inputting information is only half the story. In more sophisticated applications the user may wish the computer to output analogue or digital information in conjunction with an analogue input routine. Therefore it is important that the input interface and output interface are one and the same unit.

Many of the interfaces produced today use separate input and output modules, and this can limit the facilities available.

Another trap awaits the unwary who use the same data lines between interface and computer for both input and output information. Digital or analogue outputs will be affected by subsequent inputs unless the state of the outputs is latched before moving to an input routine. Systems which do not consider this aspect of operation are severly limited.

In practice, the computer interface user will wish to use as few external devices as possible to avoid the cost of a multitude of "interface interfaces". In order that he can input from a range of standard devices he will need to have a system of input amplifiers which will give a range of input facilities. Additionally, on the digital output side he will need relays which can be operated by changing the digital outputs.

If this whole collection of inputs, outputs and amplifiers could be controlled by the computer one has an immensely powerful tool of use to everyone from the home computer enthusiast right up to the scientific researcher.

Finally, one has to decide which computer to use with this machine. The BBC Micro is a natural choice because of its flexibility, wide facilities and superb graphics capabilities. A powerful duo!

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Disc formatter

BEFORE a disc can be used to store programs, it has to be "organised" by having its surface mapped into various regions. This process is called formatting, and it provides the disc with the type of "grid-reference" system that the BBC Micro works to.

This means that even if you have all the hardware necessary – the disc interface and the drive – you cannot use a floppy disc until it has been formatted.

Acorn, however, only supply their formatting program with their own disc drives, not with their disc interface. This means that, if you buy a BBC compatible disc drive from another supplier, you are still stuck for a formatting program.

Fortunately, this month we are able to provide a formatter courtesy of Ian Hirst and Cumana Ltd.

You actually carry out the formatting by placing the unformatted ("blank") disc into the drive and running the program. It will then ask which drive is to be used and how many tracks. The program can cope with both 40 and 80 track drives.

The appropriate drive can be heard to start as the program proceeds to format each track. And it ends by asking if you wish to continue. The disc will then have been fully formatted, ready for further use.

But a word of warning. If for any reason you reformat a disc, you will lose everything you have stored on it.

```
   10 REPEAT
   20 REPEAT
   30 CLS
   40 PRINTTAB(5,2);"BBC SYSTEM DISK FOR
MATTER"
   45 PRINTTAB(5,4);"Copyright Ian R. Hi
rst"
   50 PRINTTAB(5,6);"FORMAT WHICH DRIVE
";
   60 INPUT DRNUM$
   70 D%=VAL(DRNUM$)
   80 UNTIL D%<4
   90 REPEAT
  100 PRINTTAB(5,10);"
                    "
  110 PRINTTAB(5,10);"40 OR 80 TRACKS PE
R SIDE ";
  120 INPUTTN$:TN%=VAL(TN$)
  130 UNTIL TN%=40 OR TN%=80
  140 PRINTTAB(5,15);"ARE YOU SURE ???";
  150 INPUTA$
  160 UNTIL LEFT$(A$,1)="Y" OR LEFT$(A$,
1)="y"
  165 PRINT
  170 DIM B%20,S%300,V%20,Z%600
  180 OSWORD=&FFF1
  190 E%=0
  200 B%?0=D%    :REM DRIVE NUMBER
  210 B%!1=Z%    :REM BUFFER ADDRESS DUMM
Y
  220 B%?5=1     :REM ONE PARAMETER
  230 B%?6=&69   :REM SEEK COMMAND
  240 B%?7=0     :REM TRACK ZERO
  250 X%=B%:Y%=X%DIV256:A%=&7F:CALL OSWO
RD
  260 REM SECTOR LIST (S% POINTS TO IT)
  270 FOR U%=0 TO 9  :REM SECTOR
  280 S%?(U%*4+1)=0     :REM HEAD
  290 S%?(U%*4+3)=1     :REM 256 BYTES
  300 NEXT U%
  310 REM  SET UP FCB FOR FORMAT (USE B%
 )
  320 B%!1=S%     :REM BUFFER ADDRESS
  330 B%?5=5    :REM 5 PARAMETERS
  340 B%?6=&63 :REM FORMAT COMMAND
  350 B%?8=&10 :REM GAP3=&1B
  360 B%?9=&2A :REM 256 BYTES AND 10 SEC
TOR
  370 B%?10=0  :REM GAP 5=6
  380 B%?11=&10 :REM GAP 1 =&16
  390 REM  SET UP FCB FOR VERIFY (USE V%
 )
  400 REM
  410 V%?0=D% :REM DRIVE NUMBER
  420 V%!1=Z% :REM BUFFER ADDRESS
  430 V%?5=3  :REM NUMBER OF PARAMETERS
  440 V%?6=&5F  :REM VERIFY
  450 V%?8=0  :REM SECTOR NUMBER
  460 V%?9=&2A   :REM 256 BYTE X 10 SECT
OR
  470 FOR T%=0 TO TN%-1
  480 REM AMMEND SECTOR LIST FOR CURRENT
 TRACK
  490 O%=7+7*T%   :REM SECTOR OFFSET
  500 FOR U%=0 TO 9
  510 S%?(U%*4+0)=T%
  520 S%?(U%*4+2)=(O%+U%)MOD10 :REM SECT
OR NUMBER
  530 NEXT U%
  540 B%?7=T%
  550 V%?7=T%
  555 @%=&00000004
  560 PRINTT%;
  570 REM   FORMAT TRACK T%
  580 X%=B%:Y%=X%DIV256:A%=&7F:CALL OSWO
RD
  590 IF X%?12<>0  THEN PRINT" DISK ERRO
R":END
  600 E%=0
  610 REPEAT
  620 X%=V%:Y%=X%DIV256:A%=&7F:CALL OSWO
RD
  630 E%=E%+1
  640 UNTIL E%>10 OR X%?10=0
  650 IF E%=1THEN PRINT" "; ELSE PRINT;"
?";
  660 NEXT T%
  670 IF E%>10 THEN PRINT"DISK ERROR":EN
D
  680 REM SET UP DIRECTORY
  690 FOR U%=0 TO 511:Z%?U%=0:NEXTU%
  700 Z%?262=(TN%*10 DIV 256):REM MSB OF
 NUMBER OF SECTORS
  710 Z%?263=(TN%*10 MOD 256):REM LSB OF
 NUMBER OF SECTORS
  720 REM SET UP FCB FOR WRITE OF FIRST
 TWO SECTORS
  730 B%!1=Z%  :REM BUFFER ADDRESS
  740 B%?5=3   :REM NUMBER OF PARAMETERS
  750 B%?6=&4B :REM WRITE COMMAND
  760 B%?7=0   :REM TRACK ZERO
  770 B%?8=0   :REM SECTOR ZERO
  780 B%?9=&22 :REM 256 BYTES PER SECTOR
, 2 SECTORS
  790 X%=B%:Y%=X%DIV256:A%=&7F:CALL OSWO
RD
  800 IF B%?10<>0 THEN PRINT'"DISC ERROR
"
  810 PRINT''"FORMAT ANOTHER DISK?";
  820 INPUT A$
  830 IF LEFT$(A$,1)="Y" OR "y"=LEFT$(A$
,1) THEN 10
```

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ADD A BASIC DISASSEMBLER TO YOUR BEEB

THE BBC Micro is an amazing machine. But even though it has much better Basic than most other microcomputers, it is still necessary to use machine code routines for reasons of speed, compactness or a need to do something that Basic cannot.

It seems strange that it does not have a disassembler built in, as it already has a powerful assembler. To rectify this omission, here is a disassembler in Basic.

One way to see what is happening in machine code is to simply peek locations using the BBC Micro's '?' indirect operator.

This is not very useful, as all you see is a number between 0 and 255.

This is where the disassembler comes in – it will translate these numbers into mnemonics which are more readily understood. Also it will sort out how many bytes following the instruction are to be included, as there are some 13 different addressing modes on the 6502.

For example, with the mnemonic LDA (which stands for LoaD Accumulator) the byte following could be data (in the immediate mode) or a two or one byte address.

In addition, this disassembler also prints out the binary values and printable Ascii codes of data bytes in the immediate mode, a very useful facility.

The program has been designed so that the mnemonics in the data statements could easily be altered for use with other microprocessors (if the correct data is inserted!). Also there are a number of instructions that do not figure in the "official" manual which could be added at a later date.

Included in the program is a hex dump facility which not only displays the bytes between the addresses specified, but also "translates" the bytes into their Ascii characters (if printable). This aids in finding instructions and error messages in the operating system.

JIM NOTMAN reads you through his program . . .

Lines	
20-40	Set MODE 7 (to use least memory). Read data into the array D$( )
50-100	Print title and select options.
110-150	Get start and end addresses. Note that they are input as strings and the EVAL statement is used so that hexadecimal numbers, prefixed by '&' can be used.
180	Sets print formating
200-230	?ADDRESS looks at the value of memory location ADDRESS and sets INFO$ with the relevant data. OP$ = the opcode mnemonic. BYTES = the number of bytes to be included after the opcode. TYPE = addressing mode.
240-290	Hex print-out of ADDRESS plus relevant bytes and mnemonic.
300-430	Selects the correct procedure for the addressing type.
450	Updates current ADDRESS
460-470	Allows hard copy to be paged for neat looking copy (N.B. you will have to set up the commands for your printer before you run the program.)
490	Switch off printer and paging mode.
500-510	The *FX15,1 will empty the buffer before the GET command in 510
530-960	Procedures to deal with various addressing modes.
1290-1600	Data table. The data statements are composed of three essential pieces of information: a. The number of data bytes following the instruction b. The mnemonic c. The addressing type

The listing was produced from a program tape and has been tested on both 0.1 and 1.00 operating systems. When typing in the data it makes life easier to set one of the function keys to the error code, such as *KEY"0??? " where two spaces follow the question marks.

This is used to indicate an invalid opcode. It usually means that the wrong entry point has been used, or that you are trying to disassemble a data table!

If you keep all the data items 6 bytes long it will be easier to check for errors or omissions.

6502 ADDRESSING MODES

TYPE	
0	Implied
1	Immediate
2	Absolute
3	Absolute,X
4	Absolute,Y
5	Relative
6	Zero page
7	Zero page,X
8	Zero page,Y
9	Accumulator
10	(Absolute indexed)
11	(Pre-indexed indirect,X)
12	(Post-indexed indirect),Y

→

Disassembler listing

```
   10 REM Jim Notman 1983
   20 MODE7
   30 PRINTTAB(6)'"6502 DISASSEMBLER IN
BASIC"
   40 DIM D$(255) :line=1
   50 FOR I%=0TO255:READ D$(I%):NEXT
   60 PRINT''" 1..Disassemble"'" 2..Memo
ry Dump"'" 3..End Program"
   70 G=GET-48:IFG <1 OR G>3 THEN 70
   80 IFG=3THEN@%=&A0A:VDU12:END
   90 PRINT'"Printer (Y/N)"
  100 P=GET:IF P<>89 AND P<>78 THEN90
  110 INPUT'"Start address  "ADDRESS$
  120 ADDRESS=EVAL(ADDRESS$)
  130 INPUT'"Finish address "ADDRESS$
  140 FINISH=EVAL(ADDRESS$)
  150 IF FINISH <= ADDRESS THEN PRINT'"T
hat's silly":GOTO110
  160 VDU12:IFP=89 THEN P=TRUE:VDU2,15
ELSE P=FALSE:VDU3,14
  170 IF G=2 THEN PROCdump:GOTO60
  180 @%=&01000404
  190 REPEAT
  200 INFO$=D$(?ADDRESS)
  210 BYTES=VAL(INFO$)
  220 OP$=MID$(INFO$,2,3)
  230 TYPE=VAL(MID$(INFO$,5))
  240 PRINT~ADDRESS;
  250 FORI%=0TO BYTES
  260 PRINT,~?(ADDRESS+I%);
  270 NEXT
  280 ADDRESS=ADDRESS+1
  290 PRINTTAB(17)OP$;
  300 IF TYPE=0THEN 440
  310 ON TYPE GOTO320,330,340,350,360,37
0,380,390,400,410,420,430
  320 PROCimm :GOTO440
  330 PROCabs :GOTO440
  340 PROCabsX:GOTO440
  350 PROCabsY:GOTO440
  360 PROCrel :GOTO440
  370 PROCzero:GOTO440
  380 PROCzeroX:GOTO440
  390 PROCzeroY:GOTO440
  400 PROCacc  :GOTO440
  410 PROCind  :GOTO440
  420 PROCindX :GOTO440
  430 PROCindY :GOTO440
  440 PRINT
  450 ADDRESS=ADDRESS+BYTES
  460 IF P THENline=line+1
  470 IF line>=60 THEN PROCpage
  480 UNTIL ADDRESS>=FINISH
  490 VDU3,15
  500 PRINT'"Press space bar to continue
":*FX15,1
  510 IF GET<>32 THEN510
  520 VDU12:GOTO60
  530 DEFPROCimm
  540 IMM=?ADDRESS
  550 PRINT" #&";~IMM;:PROCbinary(IMM)
  560 IF IMM>31 ANDIMM<127THEN PRINT" '"
CHR$(IMM)"'";
  570 ENDPROC
  580 DEFPROCabs
  590 PRINT" &";~(256*(ADDRESS?1)+?ADDRE
SS);
  600 ENDPROC
  610 DEFPROCabsX
  620 PROCabs
  630 PRINT;",X";
  640 ENDPROC
  650 DEFPROCabsY
  660 PROCabs
  670 PRINT;",Y";
  680 ENDPROC
  690 DEFPROCrel
  700 offset=(?ADDRESS)+1
  710 IF offset>127 THEN offset=offset-2
56
  720 BRANCH=ADDRESS+offset
  730 PRINT" &";~BRANCH;
  740 ENDPROC
  750 DEFPROCzero
  760 PRINT" &";~?ADDRESS;
  770 ENDPROC
  780 DEFPROCzeroX
  790 PROCzero
  800 PRINT;",X";
  810 ENDPROC
  820 DEFPROCzeroY
  830 PRINT;",Y";
  840 ENDPROC
  850 DEFPROCacc
  860 PRINT;" A";
  870 ENDPROC
  880 DEFPROCind
  890 PRINT" (&";~(?ADDRESS+(256*(ADDRES
S?1)));")";
  900 ENDPROC
  910 DEFPROCindX
  920 PRINT" (&";~(?ADDRESS)",X)";
  930 ENDPROC
  940 DEFPROCindY
  950 PRINT" (&";~(?ADDRESS)"),Y";
  960 ENDPROC
  970 DEFPROCbinary(IMM)
  980 PRINTTAB(25)" %";
  990 FORI%=7TO0STEP-1
 1000 IF(2^I% AND IMM)=2^I% THEN PRINT"1
"; ELSE PRINT"0";
 1010 NEXT
 1020 ENDPROC
 1030 DEFPROCpage
 1040 line=1
 1050 PRINT''''''
 1060 ENDPROC
 1070 DEFPROCdump
 1080 @%=&01000203
 1090 REPEAT
 1100 PRINT~ADDRESS;
 1110 FORI%=0TO7
 1120 PRINT~ADDRESS?I%;
 1130 NEXT
 1140 PRINT" ";
 1150 FORI%=0TO7
 1160 V=ADDRESS?I%
 1170 IF(V<32)OR(V>126) THENPRINT"."; EL
SE PRINT CHR$(V);
 1180 NEXT
 1190 PRINT
 1200 ADDRESS=ADDRESS+8
 1210 IF P THEN line=line+1
 1220 IF line>=60 PROCpage
 1230 UNTIL ADDRESS>FINISH
 1240 VDU3,15
 1250 PRINT'"Press space bar to continue
":*FX15,0
 1260 IF GET<>32 THEN1260
 1270 VDU12
 1280 ENDPROC
 1290 DATA 0BRK0 ,1ORA11,0???  ,0???  ,0
???  ,1ORA6 ,1ASL6 ,0???
 1300 DATA 0PHP0 ,1ORA1 ,0ASL9 ,0???  ,0
???  ,2ORA2 ,2ASL2 ,0???
 1310 DATA 1BPL5 ,1ORA12,0???  ,0???  ,0
???  ,1ORA7 ,1ASL7 ,0???
 1320 DATA 0CLC0 ,2ORA4 ,0???  ,0???  ,0
???  ,2ORA3 ,2ASL3 ,0???
 1330 DATA 2JSR2 ,1AND11,0???  ,0???  ,1
BIT6 ,1AND6 ,1ROL6 ,0???
 1340 DATA 0PLP0 ,1AND1 ,0ROL9 ,0???  ,2
BIT2 ,2AND2 ,2ROL2 ,0???
```

```
 1350 DATA 1BMI5 ,1AND12,0???  ,0???  ,0
???  ,1AND7 ,1ROL7 ,0???
 1360 DATA 0SEC0 ,2AND4 ,0???  ,0???  ,0
???  ,2AND3 ,2ROL3 ,0???
 1370 DATA 0RTI0 ,1EOR11,0???  ,0???  ,0
???  ,1EOR6 ,1LSR6 ,0???
 1380 DATA 0PHA0 ,1EOR1 ,0LSR9 ,0???  ,2
JMP2 ,2EOR2 ,2LSR2 ,0???
 1390 DATA 1BVC5 ,1EOR12,0???  ,0???  ,0
???  ,1EOR7 ,1LSR7 ,0???
 1400 DATA 0CLI0 ,2EOR4 ,0???  ,0???  ,0
???  ,2EOR3 ,2LSR3 ,0???
 1410 DATA 0RTS0 ,1ADC11,0???  ,0???  ,0
???  ,1ADC6 ,1ROR6 ,0???
 1420 DATA 0PLA0 ,1ADC1 ,0ROR9 ,0???  ,2
JMP10,2ADC2 ,2ROR2 ,0???
 1430 DATA 1BVS5 ,1ADC12,0???  ,0???  ,0
???  ,1ADC7 ,1ROR7 ,0???
 1440 DATA 0SEI0 ,2ADC4 ,0???  ,0???  ,0
???  ,2ADC3 ,2ROR3 ,0???
 1450 DATA 0???  ,1STA11,0???  ,0???  ,1
STY6 ,1STA6 ,1STX6 ,0???
 1460 DATA 0DEY0 ,0???  ,0TXA0 ,0???  ,2
STY2 ,2STA2 ,2STX2 ,0???
 1470 DATA 1BCC5 ,1STA12,0???  ,0???  ,1
STY7 ,1STA7 ,1STX8 ,0???
 1480 DATA 0TYA0 ,2STA4 ,0TXS0 ,0???  ,0
???  ,2STA3 ,0???  ,0???
 1490 DATA 1LDY1 ,1LDA11,1LDX1 ,0???  ,1
LDY6 ,1LDA6 ,1LDX6 ,0???
 1500 DATA 0TAY0 ,1LDA1 ,0TAX0 ,0???  ,2
LDY2 ,2LDA2 ,2LDX2 ,0???
 1510 DATA 1BCS5 ,1LDA12,0???  ,0???  ,1
LDY7 ,1LDA7 ,1LDX8 ,0???
 1520 DATA 0CLV0 ,2LDA4 ,0TSX0 ,0???  ,2
LDY3 ,2LDA3 ,2LDX4 ,0???
 1530 DATA 1CPY1 ,1CMP11,0???  ,0???  ,1
CPY6 ,1CMP6 ,1DEC6 ,0???
 1540 DATA 0INY0 ,1CMP1 ,0DEX0 ,0???  ,2
CPY2 ,2CMP2 ,2DEC2 ,0???
 1550 DATA 1BNE5 ,1CMP12,0???  ,0???  ,0
???  ,1CMP7 ,1DEC7 ,0???
 1560 DATA 0CLD0 ,2CMP4 ,0???  ,0???  ,0
???  ,2CMP3 ,2DEC3 ,0???
 1570 DATA 1CPX1 ,1SBC11,0???  ,0???  ,1
CPX6 ,1SBC6 ,1INC6 ,0???
 1580 DATA 0INX0 ,1SBC1 ,0NOP0 ,0???  ,2
CPX2 ,2SBC2 ,2INC2 ,0???
 1590 DATA 1BEQ5 ,1SBC12,0???  ,0???  ,0
???  ,1SBC7 ,1INC7 ,0???
 1600 DATA 0SED0 ,2SBC4 ,0???  ,0???  ,0
???  ,2SBC3 ,2INC3 ,0???
```

To illustrate the use of the HEX dump we have dumped the first 256 bytes of the disassembler program.

```
E00  D  0  A 15 F4 20 4A 69 ..... Ji
E08 6D 20 4E 6F 74 6D 61 6E m Notman
E10 20 31 39 38 33  D  0 14  1983...
E18  6 EB 37  D  0 1E 25 F1 ..7...%.
E20 8A 36 29 27 22 36 35 30 .6)'"650
E28 32 20 44 49 53 41 53 53 2 DISASS
E30 45 4D 42 4C 45 52 20 49 EMBLER I
E38 4E 20 42 41 53 49 43 22 N BASIC"
E40  D  0 28 15 DE 20 44 24 ..(.. D$
E48 28 32 35 35 29 20 3A 6C (255) :l
E50 69 6E 65 3D 31  D  0 32 ine=1..2
E58 19 E3 20 49 25 3D 30 B8 .. I%=0.
E60 32 35 35 3A F3 20 44 24 255:. D$
E68 28 49 25 29 3A ED  D  0 (I%):...
E70 3C 3C F1 27 27 22 20 31 <<.''" 1
E78 2E 2E 44 69 73 61 73 73 ..Disass
E80 65 6D 62 6C 65 22 27 22 emble"'"
E88 20 32 2E 2E 4D 65 6D 6F  2..Memo
E90 72 79 20 44 75 6D 70 22 ry Dump"
E98 27 22 20 33 2E 2E 45 6E '" 3..En
EA0 64 20 50 72 6F 67 72 61 d Progra
EA8 6D 22  D  0 46 1D 47 3D m"..F.G=
EB0 A5 2D 34 38 3A E7 47 20 .-48:.G 
EB8 3C 31 20 84 20 47 3E 33 <1 . G>3
EC0 20 8C 20 8D 44 46 40  D  . .DF@.
EC8  0 50 16 E7 47 3D 33 8C .P..G=3.
ED0 40 25 3D 26 41 30 41 3A @%=&A0A:
ED8 EF 31 32 3A E0  D  0 5A .12:...Z
EE0 17 F1 27 22 50 72 69 6E ..'"Prin
EE8 74 65 72 20 28 59 2F 4E ter (Y/N
EF0 29 22 20 20  D  0 64 1D )"  ..d.
EF8 50 3D A5 3A E7 20 50 3C P=.:. P<
```

```
DD0  48          PHA
DD1  20  21  F5 JSR &F521
DD4  68          PLA
DD5  60          RTS
DD6  C9  91      CMP #&91 %10010001
DD8  D0  14      BNE &DEE
DDA  E0   0      CPX #&0  %00000000
DDC  D0  10      BNE &DEE
DDE  BA          TSX
DDF  BD   2   1 LDA &102,X
DE2  C9  F7      CMP #&F7 %11110111
DE4  F0   B      BEQ &DF1
DE6  A2   0      LDX #&0  %00000000
DE8  A9  91      LDA #&91 %10010001
DEA  8D   9  FE STA &FE09
DED  60          RTS
DEE  6C  60  DB JMP (&DB60)
DF1  68          PLA
DF2  68          PLA
DF3  20  D8  F9 JSR &F9D8
DF6  20  7B  FB JSR &FB7B
DF9  20  E8   D JSR &DE8
DFC  4C  FB  F7 JMP &F7FB
```

This is a disassembly of the cassette bugs fix program on Page 39 of the March issue of BBC Micro User.

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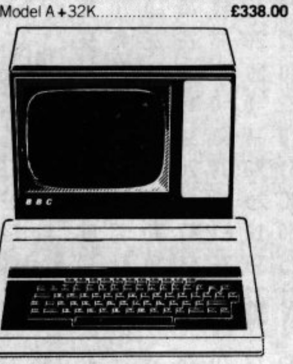

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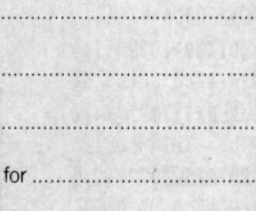

A Spectrum CENTRE

DIY listings

From Page 28

Program I

```
 10 MODE 2
 20 DIM A%(1000)
 30 SCALE=.7
 40 VDU24,0;0;1280;768;
 50 GCOL0,1
 60 GCOL0,134
 70 CLG
 80 VDU 28,0,6,19,0
 90 COLOUR 129
100 COLOUR7
110 CLS
120 PRINT
130 PRINT"A PLOT  OF LIGHT"
140 PRINT"INTENSITY AGAINST "
150 PRINT"TIME"
160 INPUT"NO. OF READINGS",R%
170 COLOUR11
180 PRINT"PRESS SPACE-BAR"
190 IF GET=32 THEN 200 ELSE 190
200 SOUND1,-15,150,4
210 PRINT"GO"
220 FORS%=1 TO R%
225 RDING=ADVAL(1)/65
230 A%(S%)=RDING
240 NEXTS%
250 VDU5
260 MOVE10,768:DRAW 10,40:DRAW 1200,40
270 MOVE200,30:PRINT"TIME --->"
280 X%=10
290  MOVE X%,SCALE*A%(1)
300 FORS%= 1TO R%
310 Z%=SCALE*A%(S%)
320 DRAW X%,Z%
330 X%=X%+1
340 NEXTS%
350 VDU4
360 END
```

Program II

```
   10 REM*TEMP AND LIGHT MEASURE M.SHAW*
   20 MODE 1
   30 REM*T%=TEMPERATURE L%=LIGHT*
   40 DIM T%(200),L%(200)
   50 PRINT:INPUT"DO YOU WISH TO OBTAIN
STORED DATA YES OR NO",B$
   60 IF B$="YES" THEN PROCINITIALISE:PR
OCFILE_IN :GOTO260
   70  IF B$="NO" THEN  90
   80 IF B$<>"YES" OR B$<>"NO" THEN 50
   90 PRINT:PRINT
  100 REM*SELECT CORRECT SCALING FOR TEM
P*
  110 PRINT"OPERATING RANGE 0-100 Celsiu
s"
  120 PRINT"USE VARIABLE POT. FOR ADJUST
MENT"
  130 SCALE=65
  180 PRINT:PRINT"WHAT TIME INTERVAL REQ
UIRED IN SECONDS"
  190 REM*INPUT TIME DELAY ********
  200 INPUT"MINIMUM 1 SECOND",DELAY
  210 PROCPLOT(SCALE)
  220 PRINT:INPUT"DO YOU WISH TO STORE T
HE DATA YES OR NO",A$
  230 IFA$="YES" THEN PROCFILE_OUT :GOTO
 260
  240 IFA$="NO" THEN  260
  250 IFA$<>"YES" OR A$<>"NO" THEN 220
  260 CLS:GCOL0,3:INPUT"MORE DATA YES OR
 NO",D$
  270 IF D$="YES" THEN 50 ELSE 280
  280 END
  290 DEF PROCPLOT(SCALE)
  300 REM*SET FOR ADC CHANNELS 1 AND 2 O
NLY******
  310 *FX16,2
  320 CLS
  330 VDU 5
  340 MOVE 0,1000
  350 DRAW 0,0
  360 DRAW 1200,0
  370 REM*GET TEMP AND LIGHT READINGS*
  380 T%(1)=ADVAL(2) DIV SCALE
  390 L%(1)=ADVAL(1)DIV 55
  400 X%=10
  410 FOR S%=2 TO 120
  420 T%(S%)=ADVAL(2) DIV SCALE
  430 L%(S%)=ADVAL(1) DIV 55
  440 MOVE X%,L%(S%-1)
  450 GCOL0,1
  460 DRAW X%+10,L%(S%)
  470 MOVE X%-10,T%(S%-1)
  480 GCOL0,2
  490 DRAW X%,T%(S%)
  500 TIME=0
  510 REPEAT UNTIL TIME>DELAY*100-15
  520 X%=X%+10
  530 NEXTS%
  540 VDU4
  550 ENDPROC
  560 DEF PROCFILE_OUT
  570 X=OPENOUT "DATA"
  580 FOR S%=1 TO 120
  590 PRINT#X,T%(S%),L%(S%)
  600 NEXTS%
  610 CLOSE#X
  620 ENDPROC
  630 DEF PROCFILE_IN
  640
  650 X=OPENIN "DATA"
  660 FOR S%=1 TO120
  670 INPUT#X,T%(S%),L%(S%)
  680 NEXTS%
  690 CLOSE#X
  700 PROCPLOT_2
  710 ENDPROC
  720 DEF PROCPLOT_2
  730 CLS
  740 VDU 5
  750 MOVE0,1000
  760 GCOL0,3
  770 DRAW 0,0
  780 DRAW 1200,0
  790 X%=10
  800 MOVE 0,T%(1)
  810 GCOL0,2
  820 FORS%=2 TO 120
  830 DRAW X%,T%(S%)
  840  X%=X%+10
  850 NEXTS%
  860 MOVE 0,L%(1)
  870 X%=10
  880 GCOL0,1
  890 FORS%=2 TO 120
  900 DRAW X%,L%(S%)
  910  X%=X%+10
  920 NEXTS%
  930 VDU4
  940 ENDPROC
  950 DEF PROCINITIALISE
  960 FORS%=1 TO 120
  970 T%(S%)=0
  980 L%(S%)=0
  990 NEXT
 1000 ENDPROC
```

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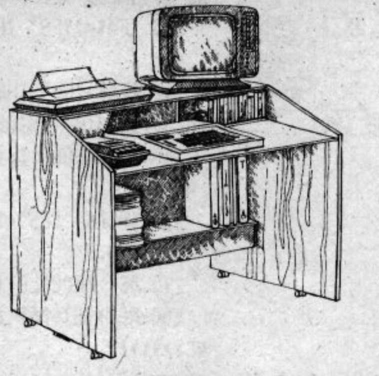

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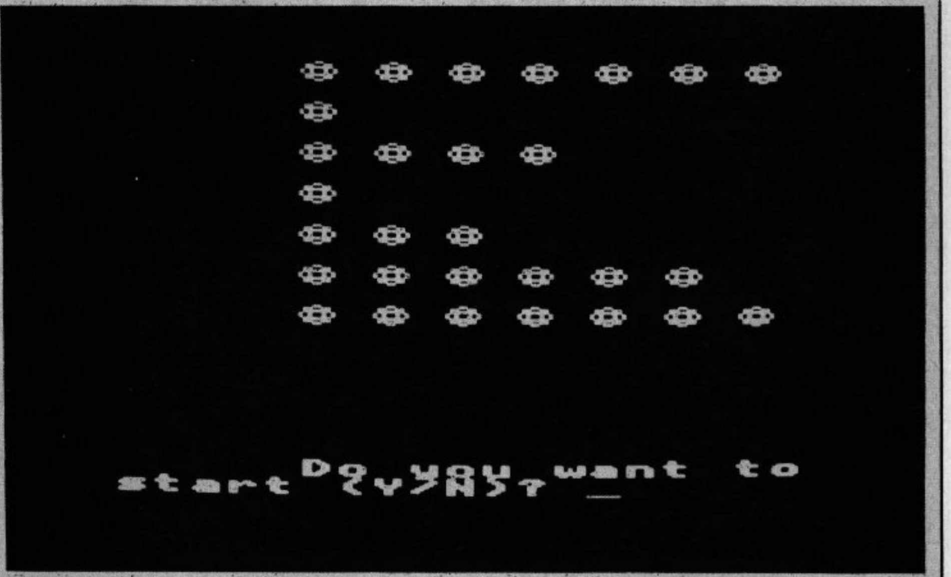
Access

VISA

NIM listing



From Page 35

```
    1  REM Copyright Sean Overend 1983
    2  REM 22 Highland Road Amersham Buc
ks
    3  REM Version /BW1
    5  MODE7
   10 PROCinitialise
   20 PROCdisplayinstructions
   25  MODE5 -
   26  IF black_white THEN VDU 19,1,15,0
,0,0,19,2,15,0,0,0:GOTO 30
   27  VDU 19,128,2,0,0,0
   28  VDU 19,3,0,0,0,0
   29  VDU 19,1,4,0,0,0
   30  REPEAT PROCplaygame: UNTIL tired=
TRUE
   35  MODE7
   40 PROCexitroutine
   50 END
  100 DEF PROCplaygame
  110 CLS
  120 PROCscoreandgameparameters
  125  IF tired THEN 150
  130 finishedgame=FALSE
  140 REPEAT PROCtaketurns: UNTIL finish
edgame
  150 ENDPROC
  200 DEF PROCinitialise
  205  LOCAL I%
  210 REM Set up NIM byte array (max row
s is 10)
  220 DIM NIM 10
  230 FOR I%=1 TO 10: NIM?I%=0: NEXT I%
  240  tired=FALSE: firsttime=TRUE: fini
shedgame=FALSE
  241  PRINT'''''"Black/white or colour?
 (B/C) ";:A$=GET$
  242  *FX 15,0
  243  IF A$="B" THEN black_white=TRUE E
LSE black_white=FALSE
  244  *FX9,5
  245  *FX10,5
 ·250 VDU23,224,24,102,126,165,165,126,1
02,24
  260 VDU23,225,126,255,153,231,231,231,
126,42
  270  VDU23,226,153,90,60,255,255,60,90
,153
  271  IF NOT black_white THEN VDU 19,3,
4,0,0,0
  280 ENDPROC
  300 DEF PROCdisplayinstructions
  310 LOCAL A$,1
  320 PROCdoubleprint("NIM",2-5*black_wh
ite,12,2)
  340  PRINT''"Take it in turns with the
 computer"'"to remove a number of nimber
s from a"'"row. Select which row using t
he ^ and "
  345  PRINT"down keys. Select how many
from each"'"row by moving the cursor sid
eways"'"with the [ and ] keys.When you a
re"
  347  PRINT"under the last one to be ta
ken from"'"the row, press RETURN"
  360  PRINT''
  370 PROCdoubleprint("HE WHO TAKES THE
LAST NIMBER LOSES",2-5*black_white,1,30)
  380 PRINT''"Tap any key when ready to
proceed"
  390 A$=GET$
  400 ENDPROC
  410 DEF PROCdoubleprint(string$,colour
,x%,y%)
  420 LOCAL col$,db$
  430 col$=CHR$(colour MOD8 +128):db$=CH
R$(141)
  440  PRINTTAB(x%,y%);db$;col$;string$
  450 PRINTTAB(x%,y%+1);db$;col$;string$
;
  460  ENDPROC
  500 DEF PROCscoreandgameparameters
  510 CLS
  520 IF NOT firsttime THEN PROCgiveinfo
  530 PROCparameters
  540 firsttime=FALSE
  550 ENDPROC
  600 DEF PROCgiveinfo
  610  PRINTTAB(2,10);"Your score :-";
  620 PRINT" ";yourscore%''
  630  PRINTTAB(2,13);"My   score :-";
  640 PRINT" ";myscore%''
  650  PRINT"Do you want another game? Y
/N ";
  655  *FX15,0
  660    A$=GET$:IF A$="N"THEN tired=TRU
E
  670  ENDPROC
  700 DEF PROCparameters
  710 LOCAL A$,B$
  715  IF tired THEN 850
  720 CLS
  725  PRINT''''''''''
  730 PRINT''"Choose size of board (3-7)
 ";
  740 *FX15,0
  750 A$=GET$
  760  BS=VAL(A$):IF BS<3 OR BS>7 THEN P
RINTCHR$(7);:GOTO 730
  770 boardsize=BS
  780 PROCsetupNIM(boardsize)
  790 CLS
  800 PROCdisplay(boardsize)
  810 PRINTTAB(5,29);"Do you want to sta
rt (Y/N)? ";
  820 *FX15,0
  830 A$=GET$
  840 IF A$="Y" THEN yourmove=TRUE ELSE
yourmove=FALSE
  845  PRINTTAB(5,29);"
           ";
  850 ENDPROC
  900 DEF PROCsetupNIM(boardsize)
  910 LOCAL I%
  920 FOR I%=1 TO boardsize
  930 NIM?I%=RND(boardsize)
  940 NEXT I%
  950 IF boardsize<10 THEN FOR I%=boards
ize+1 TO 10:NIM?I%=0:NEXT I%
  960 ENDPROC
 1000 DEF PROCdisplay(boardsize)
 1010 LOCAL I%,J%
 1020 ytab%=16-boardsize
```

→

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BARCLAYCARD VISA

NIM listing

From Page 89

```
 1030 CLS
 1040 FOR I%=1 TO boardsize
 1050 FOR J%=1 TO NIM?I%
 1060 PRINTTAB(5+2*(J%-1),ytab%+2*(I%-1)
);CHR$224;
 1070  NEXT J%
 1075  NEXT I%
 1080 ENDPROC
 1100 DEF PROCtaketurns
 1110 LOCAL result
 1120  IF yourmove THEN PROCinputyours:y
ourmove=FALSE  ELSE PROCinputmine:yourmo
ve=TRUE
 1130 result=FNsingles
 1140  IF ABS(result)=1 THEN myscore%=my
score%-(result=1):yourscore%=yourscore%-
(result=-1):finishedgame=TRUE:PROCsoundo
ff(result)
 1150  ENDPROC
 1200 DEF PROCinputyours
 1205  LOCAL valid,wholerow
 1210 LOCAL I%,A$,row%,col%
 1220  PRINTTAB(5,30);"        ":PRINTTAB
(5,30);"YOUR MOVE";
 1230 VDU 8,8,8,8,8,8,8,8,8,8,8
 1240 FOR I%=29 TO ytab% STEP-1:VDU 11:N
EXT I%
 1250 *FX15,0
 1260 A$=GET$
 1270 IF A$<>CHR$(13) THEN PRINTCHR$(7):
GOTO 1220
 1280 row%=INT((VPOS-ytab%)/2)+1
 1290 col%=INT((POS-5)/2)+1
 1300 valid=row%>0 AND row%<=boardsize A
ND NIM?row%>=col% AND col%>0
 1310  IF NOT valid THEN VDU7:PRINTTAB(5
,30)"        ";:PRINTTAB(5,30);"Invalid":
FOR I%=1 TO 1000:NEXT I%:GOTO 1220
 1315  COLOUR 2
 1320 FOR I%=1 TO col%
 1330 PRINTTAB(5+2*(I%-1),ytab%+2*(row%-
1));CHR$226
 1340 NEXT I%
 1345  COLOUR 3
 1350 wholerow=(NIM?row%=col%)
 1360  IF wholerow THEN PROCdeleterow(ro
w%) ELSE PROCadjustrow(row%,col%)
 1370  ENDPROC
 1400  DEF PROCadjustrow(row%,col%)
 1410 FOR I%=1 TO 4000:NEXT I%
 1420 FOR I%=1 TO NIM?row%
 1430 PRINTTAB(5+2*(I%-1),ytab%+2*(row%-
1));CHR$32
 1440 NEXT I%
 1450 NIM?row%=NIM?row%-col%
```

```
 1460 FOR I%=1 TO NIM?row%
 1470 PRINTTAB(5+2*(I%-1),ytab%+2*(row%-
1));CHR$224
 1480 NEXT I%
 1490 ENDPROC
 1500  DEF PROCdeleterow(row%)
 1510 FOR I%=1 TO 4000:NEXT I%
 1520 IF row%=boardsize THEN 1560
 1530 FOR I%=row% TO boardsize-1
 1540 NIM?I%=NIM?(I%+1)
 1550 NEXT I%
 1560 boardsize=boardsize-1
 1570 PROCdisplay(boardsize)
 1580 ENDPROC
 1700 DEF FNsingles
 1710 LOCAL ones,result
 1720 ones=0
 1730 FORI%=1 TO boardsize
 1740 IF NIM?I%=1 THEN ones=ones+1
 1750 NEXT I%
 1760 IF ones<boardsize THEN result=0:GO
TO 1780
 1770 IF (boardsize MOD2=1)EOR yourmove
THEN result=-1 ELSE result=1
 1780 =result
 1800 DEF PROCinputmine
 1810 LOCAL ones,wholerow,row%,col%
 1820  ones=0
 1825  PRINTTAB(5,30);"MY MOVE      ";
 1830 FOR I%=1 TO boardsize
 1840 ones=ones-(NIM?I%=1)
 1850 NEXT I%
 1860    IF ones=boardsize-1 THEN PROCsi
ngleup : GOTO 1880
 1870  IF FNnotwinnable THEN PROCtakeany
one
 1880   COLOUR1
 1890 FOR I%=1 TO col%
 1900  PRINTTAB(5+2*(I%-1),ytab%+2*(row%
-1));CHR$225
 1910 NEXT I%
 1915  FOR I%=1 TO 5000:NEXT I%
 1920 COLOUR3
 1930 IF wholerow THEN PROCdeleterow(row
%) ELSE PROCadjustrow(row%,col%)
 1940 ENDPROC
 2000  DEF PROCsingleup
 2010  IF ones MOD 2 THEN wholerow=TRUE
ELSE wholerow=FALSE
 2020 FOR I%=1 TO boardsize
 2030 IF NIM?I%>1 THEN row%=I%
 2040 NEXT I%
 2050 col%=NIM?row%-1-wholerow
 2060 ENDPROC
 2100  DEF FNnotwinnable
 2110 LOCAL mask%,I%,add%
 2120 mask%=0
```

```
 2130 FOR I%=1 TO boardsize
 2140 mask%=mask% EOR NIM?I%
 2150 NEXT I%
 2160 IF mask%=0 THEN=TRUE
 2161   IF mask%=1 THEN test%=1:GOTO 217
0
 2162  FOR I%=3 TO 1 STEP-1
 2164  test%=2^I%
 2166  IF mask%>=test%THEN I%=1
 2168  NEXT I%
 2170 FOR I%=1 TO boardsize
 2180        IF (test% AND NIM?I%)=test%
THEN row%=I%
 2190 NEXT I%
 2200  IF test%<>1 THEN add%=NIM?row% AN
D mask%:col%=add%-(add% EOR mask%):ELSE
col%=1
 2210    IF col%<NIM?row% THEN wholerow=
FALSE ELSE wholerow=TRUE
 2220 =FALSE
 2300  DEF PROCtakeanyone
 2310 row%=RND(boardsize)
 2320  IF NIM?row%=1 THEN col%=1 ELSE co
l%=RND(NIM?row%)
 2325  IF col%=NIM?row% THEN wholerow=TR
UE ELSE wholerow=FALSE
 2330 ENDPROC
 2400 DEF PROCexitroutine
 2410 PROCdoubleprint("GOODBYE",3,12,20)
 2415  PRINT
 2420 ENDPROC
 2500 DEF PROCsoundoff(result)
 2505  CLS
 2507  IF NOT black_white THENVDU 19,128
,10,0,0,0
 2510 LOCAL col,chr
 2520 col=1-(result=-1)
 2530 chr=225-(result=-1)
 2540 COLOURcol
 2545  GCOL0,col
 2550 VDU5
 2560 FOR I%=1 TO 100
 2570 MOVE RND(1247)+16,RND(959)+32
 2580 VDUchr
 2590 NEXT I%
 2600 VDU4
 2610 COLOUR3
 2620 IF result=1 THEN PRINTTAB(9,15);"I
win" ELSE PRINTTAB(7,15);"You win"
 2630  SOUND 1,-15,101-28*(result=-1),25
 2631 SOUND 2,-15,133-28*(result=-1),30
 2632 SOUND 3,-15,155-28*(result=-1),40
 2633 SOUND 1,-15,101-28*(result=-1),25
 2635  FOR I%=1 TO 4000:NEXT I%
 2637  IF NOT black_white THEN VDU 19,12
8,2,0,0,0
 2640 ENDPROC
```

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Horoscope listing

From Page 71

```
   10*KEY10 OLD|M RUN|M
   20REM HOROSCOPE
   30REM (C) J.F.LORD 1983
   40MODE7:CLS
   50B%=0:C%=0:D%=0:E%=0:M%=0:Y%=0:Z=1
   60DIM D$(6)
   70FOR R=0 TO 6:READ D$(R):NEXT R
   80DATA Sunday,Monday,Tuesday,Wednesda
y,Thursday,Friday,Saturday
   90PRINT'CHR$(131);CHR$(141);TAB(10)"C
OMPUTER HOROSCOPE"
  100PRINTCHR$(131);CHR$(141);TAB(10)"CO
MPUTER HOROSCOPE"
  110PRINTTAB(0,10)"Now type in todays d
ate"
  120PRINT'"Year.....including the centu
ry"
  130PROCInteger
  140D%=NUM%
  150PRINT"Month of the year"
  160INPUT""MONTH$
  170PROCMONTH
  180IF E=1 GOTO 160
  190C%=VAL(MONTH$)
  200PRINT"Day of the month"
  210PROCInteger
  220DAY%=NUM%
  230PROCDAY(D%)
  240IF E=1 GOTO 200
  250B%=DAY%
  260PROCPACK
  270PRINTTAB(27,5);Today$
  280PROCWHATDAY(B%,C%,D%)
  290PRINT TAB(25-LEN(D$(R)),5);D$(R)
  300PRINTTAB(0,6)CHR$(130);STRING$(38,"
£")
  310PRINTTAB(0,21)CHR$(130);STRING$(38,
"£")
  320PROCMESSAGE
  330Goes=20
  340DIM NAME$(Goes):DIM BIRTH$(Goes)
  350FORI%=1 TO Goes
  360CLS
  370INPUT"TYPE IN YOUR FIRST NAME"'CN$
  380PRINT'CN$",  NOW TYPE IN YOUR SURNA
ME"
  390INPUT""NAME$(I%)
  400NAME$(I%)=NAME$(I%)+"."+CN$
  410PRINT'CN$", NOW TYPE IN YOUR DATE O
F BIRTH"
  420PRINT"DON'T WORRY I WON'T TELL ANYB
ODY !"
  430PRINT'"Year.....including the centu
ry"
  440PROCInteger
  450Y%=NUM%
  460PRINT"Month of the year"
  470INPUT""MONTH$
  480PROCMONTH
  490IF E=1 GOTO 460
  500M%=VAL(MONTH$)
  510PRINT"Day of the month"
  520PROCInteger
  530DAY%=NUM%
  540PROCDAY(Y%)
  550IF E=1 GOTO 510
  560E%=DAY%
  570BIRTH$(I%)=STR$(E%)+"/"+STR$(M%)+"/
"+STR$(Y%)
  580PROCWHATDAY(E%,M%,Y%)
  590PROCAGE
  600PRINT"and you were born on a ";D$(R
)
  610PROCMESSAGE
  620Y=INKEY(1000)
  630PROCSTAR
  640CLS
  650PRINT"YOUR STAR SIGN IS "STAR$
  660PRINT'"AND YOUR HOROSCOPE FOR THE N
EXT WEEK "'
  670IF STAR$="ARIES" GOSUB1140
  680IF STAR$="TAURUS" GOSUB1240
  690IF STAR$="GEMINI" GOSUB1340
  700IF STAR$="CANCER" GOSUB1430
  710IF STAR$="LEO" GOSUB1530
  720IF STAR$="VIRGO" GOSUB1650
  730IF STAR$="LIBRA" GOSUB1750
  740IF STAR$="SCORPIO"GOSUB1860
  750IF STAR$="SAGITTARIUS"GOSUB1990
  760IF STAR$="CAPRICORN"GOSUB2100
  770IF STAR$="AQUARIUS"GOSUB2210
  780IF STAR$="PISCES"GOSUB2320
  790T=TIME:REPEAT UNTIL TIME>T+700
  800*FX15,0
  810A$=GET$:IF A$="" THEN810
  820PROCMESSAGE
  830NEXT
  840END
  850DEFPROCSTAR
  860 IF (E%>20 AND M%=3) OR(E%<21 AND M
%=4) THEN STAR$="ARIES"
  870IF (E%>20 AND M%=4) OR(E%<22 AND M%
=5) THEN STAR$="TAURUS"
  880IF (E%>21 AND M%=5) OR(E%<23 AND M%
=6) THEN STAR$="GEMINI"
  890IF (E%>22 AND M%=6) OR(E%<24 AND M%
=7) THEN STAR$="CANCER"
  900IF (E%>23 AND M%=7) OR(E%<24 AND M%
=8) THEN STAR$="LEO"
  910IF (E%>23 AND M%=8) OR(E%<24 AND M%
=9) THEN STAR$="VIRGO"
  920IF (E%>23 AND M%=9) OR(E%<25 AND M%
=10) THEN STAR$="LIBRA"
  930IF (E%>24 AND M%=10) OR(E%<24 AND M
%=11) THEN STAR$="SCORPIO"
  940IF (E%>23 AND M%=11) OR(E%<23 AND M
%=12) THEN STAR$="SAGITTARIUS"
  950IF (E%>22 AND M%=12) OR(E%<21 AND M
%=1) THEN STAR$="CAPRICORN"
  960IF (E%>20 AND M%=1) OR(E%<19 AND M%
=2) THEN STAR$="AQUARIUS"
  970IF (E%>18 AND M%=2) OR(E%<21 AND M%
=3) THEN STAR$="PISCES"
  980ENDPROC
  990DEFPROCAGE
 1000IF Y% MOD 4=0 AND (Y% MOD 100 <>0 O
R Y% MOD 400=0) THEN LEAP=1 ELSE LEAP=0
 1010IF E%>B% AND (C%=11 OR C%=04 OR C%=
06 OR C%=09) THEN C%=C%-1:B%=B%+30
 1020IFE%>B% AND C%=02 AND LEAP=1 THEN C
%=C%-1:B%=B%+29
 1030IFE%>B% AND C%=2 AND LEAP=0 THEN C%
=C%-1:B%=B%+28
 1040IFE%>B% AND (C%=01 OR C%=03 OR C%=0
5 OR C%=07 OR C%=08 OR C%=10 OR C%=12) T
HEN C%=C%-1:B%=B%+31
 1050IF M%>C% THEN D%=D%-1:C%=C%+12
 1060CLS
 1070PRINT"SO "CN$", YOUR AGE IS ":PRINT
'TAB(5)D%-Y%" YEARS"
 1080PRINTTAB(5)C%-M%" MONTHS"
 1090PRINTTAB(5)B%-E%" DAYS"
 1100B%=VAL(LEFT$(Today$,2))
 1110C%=VAL(MID$(Today$,4,2))
 1120D%=VAL(MID$(Today$,7))
 1130ENDPROC
 1140REM HOROSCOPES ARIES
 1150PRINT"YOU MAY BE IN FOR A SURPRISE
WHERE"
 1160PRINT"BUSINESS MATTERS ARE CONCERNE
D."
 1170PRINT"CONSIDER WHAT IS INVOLVED AND
 MAKE"
 1180PRINT"CHANGES IF THEY SEEM NECESSAR
Y TO YOU"
 1190PRINT"GROUP ACTIVITIES BRING THE MO
ST"
 1200PRINT"PLEASURE THIS WEEK,BUT AVOID
 INTENSE"
 1210PRINT"RELATIONSHIPS AS THIS COULD B
E A MOODY"
 1220PRINT"TIME BOTH FOR YOU AND YOUR FR
IENDS."
 1230RETURN
 2420DEFPROCCheck
 2430ENDPROC
 2440DEFPROCMONTH
 2450E=0
 2460IF MONTH$="1" OR LEFT$(MONTH$,3)="J
AN"THEN MONTH$="01"
 2470IF MONTH$="2" OR LEFT$(MONTH$,3)="F
EB"THEN MONTH$="02"
 2480IF MONTH$="3" OR LEFT$(MONTH$,3)="M
AR"THEN MONTH$="03"
```

→

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Fast action version of the popular arcade game. 4 types of Galaxian (in 3 initial screen formations) swoop down individually or in groups of two or three. 6 skill levels, hi-score, rankings, bonus laser bases, increasing difficulty, superb graphics and sound.

CENTIPEDE (32K) £6.50 Cassette/£9.90 Disc
Incredible arcade type game featuring mushrooms, flies, snails, spiders, and the centipedes of course. Excellent graphics and sound. 6 skill levels, hi-score, rankings, bonuses, and increasing difficulty as the spiders become more active and the mushrooms increase.

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Superior version of the old classic arcade game including a few extras. 48 marching invaders drop bombs that erode your defences, and 2 types of spaceship fly over releasing large bombs that penetrate through your defences. Hi-score, increasing difficulty, superb sound effects and graphics.

SPACE FIGHTER (32K) £6.50 Cassette/£9.90 Disc
Arcade-style game based upon features from DEFENDER and SCRAMBLE. 5 types of menacing alien fire at you and may attempt to ram you. Separate attack phases, fuel dumps, asteroids, repeating laser cannon, smart bombs, hi-score, rankings, 6 skill levels, bonuses.

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Horoscope listing

From Page 93

```
 2490IF MONTH$="4" OR LEFT$(MONTH$,3)="A
PR"THEN MONTH$="04"
 2500 IF MONTH$="5" OR LEFT$(MONTH$,3)="
MAY"THEN MONTH$="05"
 2510 IF MONTH$="6" OR LEFT$(MONTH$,3)="
JUN"THEN MONTH$="06"
 2520 IF MONTH$="7" OR LEFT$(MONTH$,3)="
JUL"THEN MONTH$="07"
 2530 IF MONTH$="8" OR LEFT$(MONTH$,3)="
AUG"THEN MONTH$="08"
 2540 IF MONTH$="9" OR LEFT$(MONTH$,3)="
SEP"THEN MONTH$="09"
 2550 IF MONTH$="10" OR LEFT$(MONTH$,3)=
"OCT"THEN MONTH$="10"
 2560 IF MONTH$="11" OR LEFT$(MONTH$,3)=
"NOV"THEN MONTH$="11"
 2570 IF MONTH$="12" OR LEFT$(MONTH$,3)=
"DEC"THEN MONTH$="12"
 2580IF VAL(MONTH$)>12 PRINT"THERE ARE O
NLY 12 MONTHS IN A YEAR":E=1
 2590IF VAL(MONTH$)=0 PRINT"NAMES OF MON
THS ONLY":E=1
 2600ENDPROC
 2610DEFPROCDAY(Y%)
 2620 M%=VAL(MONTH$):E=0
 2630IF Y% MOD 4=0 AND (Y% MOD 100<>0 OR
 Y% MOD 400=0) THEN LEAP=1 ELSE LEAP=0
 2640IF M%=2 AND LEAP=1 AND DAY%>29 THEN
 PRINT"THERE ARE ONLY 29 DAYS IN FEB.":E
=1
 2650IF M%=2 AND LEAP=0 AND DAY%>28 THEN
 PRINT"THERE ARE ONLY 28 DAYS IN FEB.":E
=1
 2660IF( M%=4 OR M%=6 OR M%=9 OR M%=11)
AND DAY%>30 PRINT"THERE ARE ONLY 30 DAYS
 IN THIS MONTH":E=1
 2670IF DAY%>31 PRINT"NO MONTHS HAVE MOR
E THAN 31 DAYS":E=1
 2680IF DAY%<1 PRINT "A NUMBER IS WANTED
"
 2690ENDPROC
 2700DEFPROCInteger
 2710 LOCAL FL,Y,NUM$,E
 2720FL=0:NUM$=""
 2730*FX15,1
 2740REPEAT Y=GET
 2750IF (Y>&2F AND Y<&3A)NUM$=NUM$+STR$(
Y-48):PRINTCHR$(Y);:FL=1
 2760IFY=&7F VDU&7F:NUM$=LEFT$(NUM$,LEN(
NUM$)-1)
 2770IF Y<>&4F AND Y<>&6C THEN 2860
 2780IF Y=&4F THEN E=&30
 2790IF Y=&6C THEN E=&31
 2800 VDU&0D,&0A,&07
 2810PRINT"YOU JUST PRESSED THE LETTER "
;CHR$(Y)'"INSTEAD OF THE NUMBER ";CHR$(E
)
 2820Y=INKEY(500)
 2830  VDU&0B,&0B,&0B;:PRINTSTRING$(120,
" ")
 2840VDU&0D,&0B,&0B,&0B,&0B:PRINT NUM$;
 2850IF Y<>-1 THEN2750
 2860 IF LEN(NUM$)>4 THEN PRINT CHR$(7)'
'"YOUR NUMBER IS TOO BIG" ELSE 2890
 2870NUM$="":FL=0:FOR I=1 TO 1000:NEXT:*
FX15,1
 2880GOTO 2820
 2890UNTIL Y=&0D AND FL=1
 2900VDU&0D,&0A
 2910NUM%=VAL(NUM$)
 2920ENDPROC
 2930DEFPROCWHATDAY(DAY,MONTH,YEAR)
 2940MONTH=MONTH-2
 2950CEN=YEAR DIV 100:YEAR=YEAR MOD 100
 2960IF MONTH<1 THEN MONTH=MONTH+12:YEAR
=YEAR-1
 2970 R=INT(2.6*MONTH-0.19)+DAY+YEAR+YEA
R DIV 4 + CEN DIV 4 -2*CEN
 2980R=R MOD 7
 2990IF MONTH<11 THEN MONTH=MONTH+2:ENDP
ROC
 3000IF MONTH>10 THEN MONTH=MONTH-10:YEA
R=YEAR+1
 3010ENDPROC
 3020DEFPROCPACK
 3030IF LEN(STR$(B%))=1 THEN Today$="0"+
STR$(B%) ELSE Today$=STR$(B%)
 3040IF LEN(STR$(C%))=1 THEN Today$=Toda
y$+"/0"+STR$(C%) ELSE Today$=Today$+"/"+
STR$(C%)
 3050Today$=Today$+"/"+STR$(D%)
 3060ENDPROC
 3070DEFPROCMESSAGE
 3080Z=1-Z
 3090VDU28,0,24,39,0
 3100IF Z=0 PRINTTAB(0,23)CHR$(134)"PRES
S";CHR$(129);"RETURN"CHR$(134);"AFTER TY
PING YOUR ANSWER"
 3110IF Z=1 PRINTTAB(0,23)CHR$(136);CHR$
(134)"PRESS ANY KEY TO CONTINUE";SPC(11)
 3120VDU28,0,20,39,7
 3130ENDPROC
```

AGONY COLUMN

Something's come between us . .

Dear Aunty Beeb,

I am married to a man who is married to a computer. A BBC microcomputer to be exact, though how anyone can use the word "micro" about something that takes up half the spare bedroom and all his spare time I don't know. Anyway, for better or worse – and definitely for poorer – I have to share my husband with a machine.

Because of this I've had to learn a lot about computers whether I wanted to or not. I now know the difference between hardware and software. Hardware you can curse, thump and switch off – software you can curse but can't thump.

Also I know about bits and bytes. When he gets home from work he disappears upstairs and I don't see him until I've told him for the hundredth time that his dinner is ready – "I'll have a byte in a bit" he yells.

"Where will it end?" I ask myself. He's already written a programme to help organise the family finances and then promptly disorganised them by buying some disc drives. I shudder to think what the electricity bill will be.

It's not as though I haven't tried to take an interest in it. I've got him to try to show me how to use it, but it must be one of those things like teaching your wife to drive.

He had me type in LIST and press RETURN and announced "That's a programme on the screen". I said I'd seen better on BBC1, and he lost his temper.

Anyway, how can he teach me when he can't communicate in English? Input, output I can handle, but how can I take floppies seriously? And why say graphics when he means pictures?

And what's wrong with asking has he got a Space Invaders cartridge?

Yours, **Despondent** (age and database supplied)

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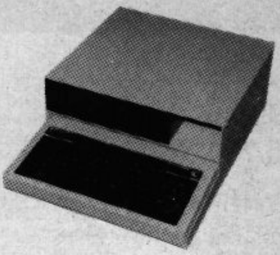

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MICROMAIL-

Unifying theme for first dedicated magazine

HAVING read the first issue of your new publication I was very impressed. Coming, as it does, from the same stable as Windfall one might have expected a pot pourri of assorted topics for users at every level.

Happily, the first issue had a unifying theme in that it is written for an audience who perhaps are experiencing their first computer and their first dedicated magazine.

I felt that you had recognised at least sectors of the user community, namely the teacher in school who should have simple electrical laboratories (your article on the analogue input/output port will excite this group), the reader new to computers and computing languages, and the hobbyist/games player. Here, your Deathwatch game seems to be arousing considerable interest.

As you know, it is very important that a dedicated magazine keeps abreast of new developments taking place at the manufacturer. Your notes on the 1.2 ROMs are a case in point.

I am sure you will want to maintain the interest of every section of the community by the range of your articles and at the same time keep all your articles, particularly the listings, error free as this is most important as your magazine will be read by the non-expert.

So, in conclusion, you have placed a pedestal before us and on it your BBC Micro User magazine. We shall look up to it. I am sure you, in turn, will maintain it that way. I wish you every success in your enterprise. – **Professor B. Richards, Head of Computation, UMIST.**

Recipe for success

WELL you asked for it! Here are my suggestions for an even better magazine.

☐ *Don't have long articles. I find reading them too much of a concentration, the way the real information is spread about. Short and sharp, please.*

☐ *Will you take up the cudgels on behalf of all the small users against Acorn over their disgusting deliveries, policies (they won't supply instructions and formatted discs, whatever they are, unless you buy their disc drives which are more expensive).*

Please be practical and let us know – in print – what success you are achieving, if any.

☐ *I'd like to see articles on programming hints, such as OSWORD and FX calls. Where, how and why should we use them?*

☐ *VAT. Please start a campaign to insist that all products advertised in BBC Micro User show the VAT inclusive price. To have to budget for an extra £150 or so is not really acceptable.*

If the purchaser is a business, then he knows he will be able to recover VAT. But to have a product advertised as "only £300" to be invoiced as £345 is very misleading.

Although the advertisers state that VAT is to be added, I still maintain it is misleading.

☐ *Finally, if I want to look at 100 pages of closely packed adverts offering me everything that I don't want, then I will read something like Practical Computing/Your Computer etc. Please don't fall into the same trap.*

I know you need adverts, but please keep them relevant and to a minimum. – **I.S. Crawford, Oxon.**

P.S. – Please accept my subscription of £10 for the next 12 issues.

Striped solution?

I HAVE a useful tip for the BBC Micro when using a poor quality TV or monitor. Type in:

```
MODE 6
VDU 19
```

After VDU 19 keep the Return key down. The result is a striped screen which makes letters easier to read.

Also I have heard rumours that the BBC is due to go down in price by £100. Could you please tell me if this is true or not? – **M. Bilton, Scholes, Leeds.**

● May I suggest that you use:

```
MODE 6
VDU 19,0,4,0,0,0
```

as the User Guide suggests, to

Male chauvinist micro, yet!

I OBJECT! Your first edition mentions husband, father, son (and Holy Ghost?) as being the owners of your computer. I thought computers were machines of the modern age!

We happen to have a BBC B computer because it was felt to be a wise investment at this stage in the family business, a 57 bedroom conference/holiday hotel owned and run by my mother, three sisters and myself.

One day, no doubt, we will be seriously considering purchase of a computer for the hotel, but in the meantime it was felt that someone ought to learn more about them in order to lessen the chances of our spending a few thousand pounds on the wrong machine!

The initial request for a micro came from our four year-old daughter who wanted a Speak and Spell and Speak and Maths but the American voice put us off.

Our 15-year-old son wanted a TV game, my husband wanted to expand his programming beyond what was allowable on his office machine. We felt that perhaps the machines in the £100-200 price range would be ideal for this, but they did not lend themselves to what I needed for experience in business machines.

So it is because I needed it that we finally purchased the BBC B.

In the two weeks since we have had the computer our daughter has taken as much interest as the rest of the family. This also includes a 3½ year old boy who can run a program happily and also found out for himself how to delete a double-printed letter after the computer had been in the house for less than 24 hours.

Feminist? No I am not. I'm just a lady who understands the woman's place in the world and cannot see why typists (traditionally women) are not also considered capable of wanting a computer to play with instead.

I have however found your first edition to be ideal for my needs. Keep it up. But remember it isn't only the men who own computers. – **Helen E. Mound (Mrs P.D.), Stratford-upon-Avon.**

● Ouch! I deserved that rebuke. As originally written the first paragraph contained none of the sexism so obvious in its final form. All I can say is that it won't happen again – I have a wife and daughter to live with . .

give you a nice white on blue effect.

As for the BBC Micro coming down in price, I think you must have heard rumours of the long-awaited Electron, a beastie of the same evolutionary line as the BBC Micro, but of a lower order.

Facts on files

I WOULD be grateful if you would explain file handling, as I have difficulty in this area.

Having read your first issue it seems to me to be the best value for money, I look forward to the next issue. – **Simon D. Watts, Guildford.**

● I have dispatched one of our tame writers to the depths of the basement with orders not to come back until he's finished a comprehensive – and comprehensible – article on files, with examples.

Bug fix bonanza

I'VE read your magazine from cover to cover, including the adverts. I won't pretend that I understand all of it but I'm trying.

I had a ZX81 which was out of commission more times than it was in. So I gave up with that but – my appetite whetted – I decided to make a more permanent addition to my telly. I bought a Beeb B a couple of weeks ago.

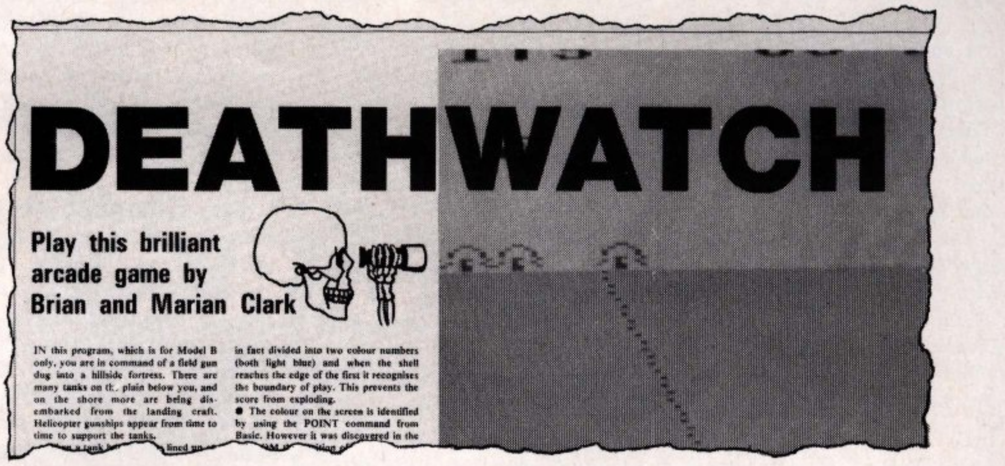
I've been typing away like mad (programs from magazines etc), bought a commercial tape, "Galaxians" by Superior Software, but had loads of problems loading.

It almost got the big E – the tape I mean – as I was beginning to think the computer was having a lot of fun at my expense.

However, due to your wonderful magazine, I found out two things:

☐ *I have an 0.10 OS Eprom (at least it says so on the screen; I've no intention of going for a*

Turn to Page 100



DEATHWATCH

Play this brilliant arcade game by Brian and Marian Clark

IN this program, which is for Model B only, you are in command of a field gun dug into a hillside fortress. There are many tanks on the plain below you, and on the shore more are being disembarked from the landing craft. Helicopter gunships appear from time to time to support the tanks.

in fact divided into two colour numbers (both light blue) and when the shell reaches the edge of the first it recognises the boundary of play. This prevents the score from exploding.

● The colour on the screen is identified by using the POINT command from Basic. However it was discovered in the

Variables table aids in the bugs battle

ACCEPT our congratulations on Vol. 1, No. 1 of the BBC Micro User magazine. We have however one or two criticisms.

We found the game "Deathwatch" very difficult to de-bug and think it would be helpful if you could follow the example of Personal Software magazine. Here we are given a table of variables and a table setting out the program structure.

This makes checking much easier and helps the beginner to understand program writing.

We also found the print in the listing very difficult to read in parts, such as Q% and @% are almost indistinguishable and led to a lot of mistakes in typing.

Once we had sorted out all the problems we found it an excellent program and a most enjoyable game. – **C. Baverstock, Wantage, Oxon.**

● Many apologies about the faint listings – it won't happen again. I agree that we should certainly try to explain our programs, and welcome your comments. However we have only a limited amount of space.

We felt that Deathwatch was already so large, and of interest primarily to gamesters, that a detailed description would have entailed giving it a disproportionate amount of space. How do other readers feel about this? We're always open to suggestions.

Download to beat memory snag

I VERY much enjoyed reading BBC Micro User and look forward to seeing many more issues.

May I offer one suggestion, namely that programs are tested on all operating systems before being listed in the magazine.

Deathwatch is an excitingly visual game, much enjoyed by our family, but under operating system 1.0 it has an absolutely lethal bug. Line 30 should read

30 MODE7:PROCTITLE:
PROCVBL:*FX11,0

for safe running. That last 0 is absolutely necessary under 1.0 otherwise the program will be subtly altered in various lines, particularly 260, with fatal results.

Another point. Deathwatch will not run under the disc system due to lack of memory. Luckily I can load it and relocate it down from &1900 to &E00.

I assume it won't run on a model A, so again, could you test programs for all models, all operating systems, with and without discs, and warn the users of possible problems. – **M.J. Parrott, Stockport.**

● Thanks for the alteration to line 30 – quite correct, as was your point about the discs. However, I can't take your point about all models, as the first line of the article specifically states that it is for Model B only.

As for the disc systems, as you suggest it can be downloaded. I usually set up one of my function keys with the following one-line program, which I keep on each of my discs:

```
     1 *KEY 0 FOR LOCATION%=PAGE TO  TOP:
?(LOCATION%-2816)=?LOCATION%: NEXT:PAGE=
&E00 |M OLD |M
```

I Chain this program, then Load Deathwatch. By pressing key *f0*, the program is downloaded in memory, ready to be Run.

From Page 99

look inside). My gratitude to Mr R.T. Russell (bug fix program) as I can now get "Galaxians" in with just a couple of rewinds instead of the usual 20. No problems with other tapes.

☐ *The Beeb Computer is mind boggling. There's so much to learn I don't think I'll ever be capable of using it to its fullest potential (I couldn't write a program to save my life) but I can operate it OK and type a bit, so I'll keep plodding on.*

One thing I'd like to ask is, as I have an Atari joystick, is it possible to use this on the Beeb with a little alteration (as per page 20 of the magazine)?

I've sent for the 12 issues offer for £10. Never thought I'd do that. I don't usually write to magazines either, so I must be quite impressed. – **Tom Wilkins, Gateshead.**

● Glad that you liked our first issue. As for the Atari joysticks, next month Mike Cooke explains how to set about making your own.

Trouble with *FXO

IF you can keep the same balance in future issues as in No. 1, I for one will be most grateful.

*Many of us will be considering discs, printers, etc – your guidance and advice would prove most useful. I tried *FX0, (page 36) – it did not work* – **C.J. Flynn, Bury.**

● I'm at a loss as to why *FXO doesn't work – it's never failed for me. I can only suppose you must have perpetrated one of the following:

☐ Used the letter O instead of the number 0.

☐ Used lower case instead of caps.

☐ Failed to press Return after typing the line.

Short changed!

I HAVE just finished reading your first issue of BBC Micro User. It is packed with really excellent material, and I want to send you my warmest congratulations, well done!

I found Paul Beverley's article on operating systems very illuminating, and it compelled me to let you know my feelings on the subject.

Beverley led me to discover how I have been rewarded for succumbing to my enthusiasm for the BBC Micro, when I bought a model B last November.

Now I know I have a ROM based 0.1 operating system machine, and, like probably many others, I feel very disappointed to realise that, after having paid the same price as that of the fully developed 1.2 version computer produced nowadays, unless I spend an additional £11.50, I am left with an inferior machine and missing on a vast number of facilities.

One would think that after the enormous success that the BBC Micro is having, Acorn could have the elegance to recall all the underdeveloped 0.1 models and bring them up to the standard specified, free of charge, no strings attached.

BBC Micro User is, judging it by your first issue, the most exciting event since the creation of the BBC Micro itself. It will surely give the BBC Micro user a wide scope of ideas and invaluable help in getting the best out of our machines. Many thanks. – **J. Suriol, Hove.**

● Acorn point out that the fee you pay will include a thorough checking of the system's "health" as well as the upgrade.

Hardware on its way

EXCELLENT magazine, just what we've all been waiting for. Hope you keep a half page for editorial, it's nice to know what you lot think!

For future issues – dissect disc drives and floppies and printers, in fact any Beeb add on device. Show us pictures of their innards and how they work. Good luck. – **R.E. Gill, Middlewich.**

● Thanks for the praise. We're going to keep the editorial, though you've no idea how much extra work it takes! As for the hardware, there's going to be plenty on the subject in future issues.

Good spot for chips

PLEASE could you tell me where I can buy any IC memory expansion chips, as I am interested in the article you did about upgrading your micro on your own.

I would be pleased if you could tell me this as I feel that with more memory I could write better and more varied software. I would prefer it if you could give me the addresses of ones in my vicinity. – **Tom Lenham, Kingston.**

● Try Watford Electronics, 33b Cardiff Road, Watford, Herts. (0923) 40588.

Keep it simple

A GREAT magazine, especially for absolute beginners like me. It's simple and straightforward. Hope you keep it that way. – **A. Charnock, Sale, Cheshire.**

And finally, with tongue firmly in cheek . . .

Missive from a faint-hearted micro user

Dear Trev,

You know, it's an ill wind that blows, etc. Well Auntie Di finally has . . . . died, I mean, and she's turned up trumps in the will. She's left me £400 on condition that I spend it entirely on myself on something I've wanted but not been able to afford.

Andrea thinks this is a dig at her, and she's probably right – Auntie Di never liked her, especially after that incident with the plastic illuminated gondola she brought back from Venice. Still, don't think ill of the dead and all that.

Anyway, with my windfall I did it. I went out and bought myself a brand new BBC Micro and with the quid left over I bought a copy of BBC Micro User. The pretty little girl salesperson at Central Processors was ever so nice and showed me all about the Micro, leaning over my shoulder to help me with the keyboard. She certainly seems to know what she's doing.

A. thought I was a fool and said so, repeatedly. She said it was a complete waste of money and I countered by saying it would have practical uses, which was a mistake because her reply was an acid "I know what 3+4 is without paying £400." I ignored this and told her I'd write a program to help with the household bills. "It's helped already," came the icy reply.

Mind you, I had a nerve saying that, as I haven't even opened the manual yet. A. won't let me unpack the thing until I've redecorated the spare room. What she doesn't know yet is that I'm going to annex it for my Micro.

As usual, though, it's A. who's had the last laugh. Central Processors rang to say my cheque had bounced, so I rang my bank manager to remonstrate and point out Auntie Di's magnificent bequest.

A. loved the reply: "Sorry, it must be a computer error."

Cheers, Bob.

P.S. Why don't they include cassette leads, or at least tell you that you need them when you buy the Micro? Do BL make cars with engines and petrol tanks but no fuel lines? No, don't answer that.

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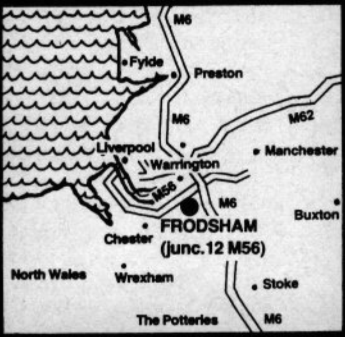
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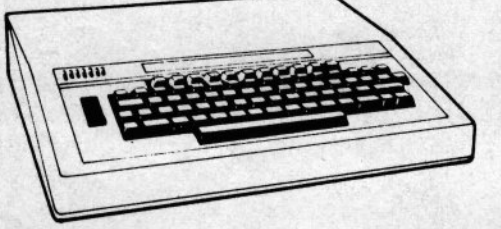

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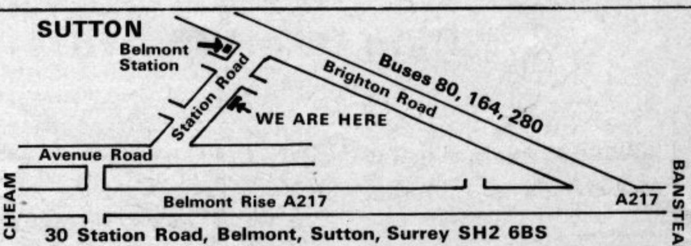
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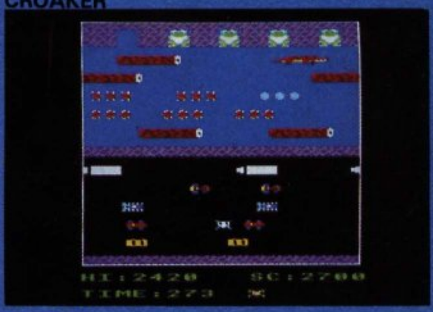

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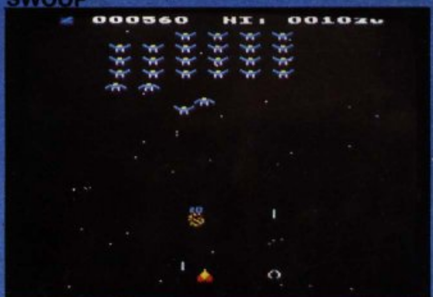

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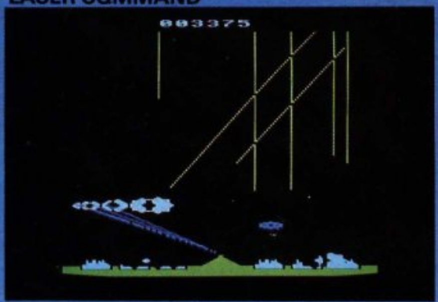

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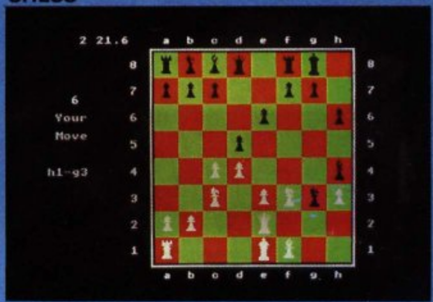

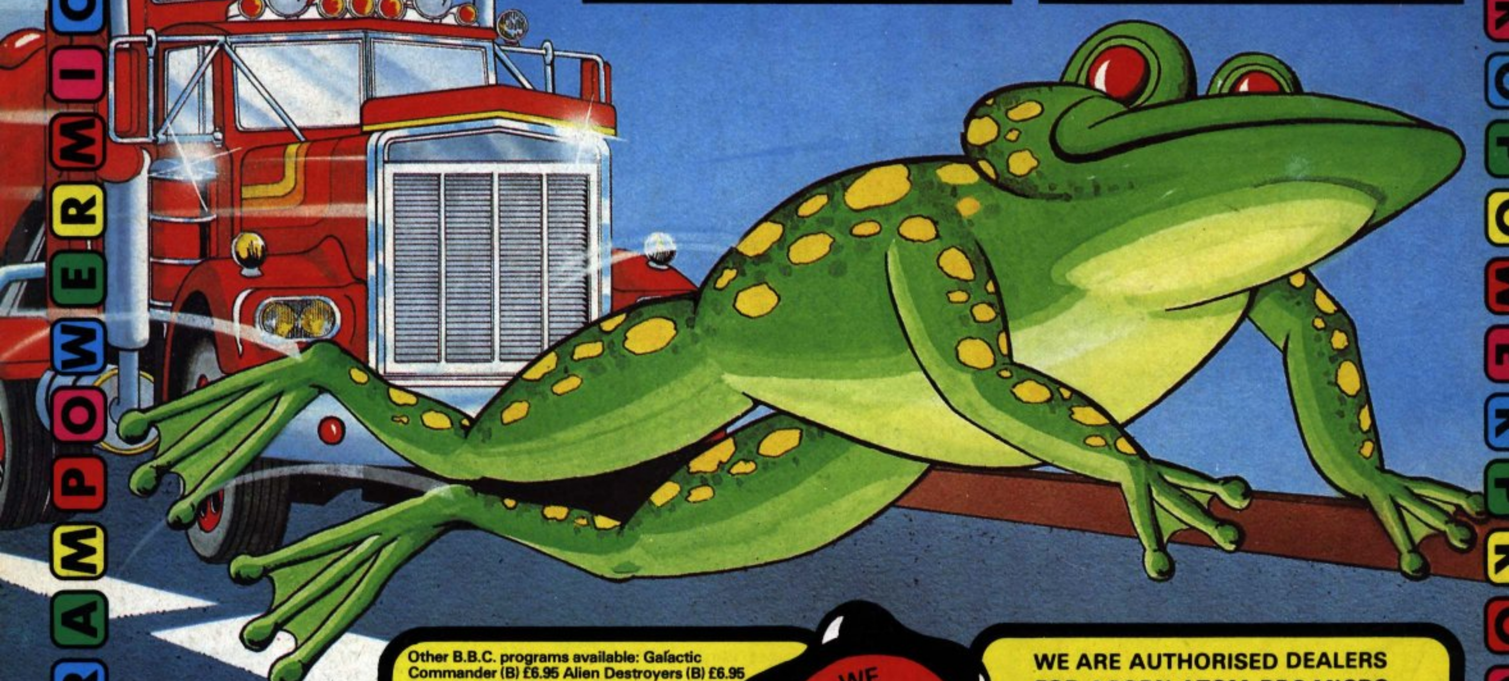

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